TIMELINE OF SELECTED REPORTS AND EVENTS 1952 – 2019 IN RELATION TO THE CONTROL OF THERMAL ENVIRONMENTS USING REFLECTIVE AND BULK INSULATION MATERIALS AS PART OF RESIDENTIAL BUILDING ENERGY EFFICIENCY REGULATIONS IN AUSTRALIA

including insulation materials forming part of cooling and heating systems and particularly cooling ductwork in roof spaces, condensation and vapour movement

As at 18 September, 2019

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Affiliate Member AIRAH – The Australian Institute of Refrigeration & Heating
President – AFICA: Aluminium Foil Insulation Council of Australia (Inc) - 2019

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*Ted Renouf (deceased 2012) – pioneer of the aluminium foil insulation industry in Australia, and Managing Director of Renhurst Industries P/L (RENFOIL) 1960-1970, and Hilton Batt - former Technical Manager

*Brian Tikey (deceased 2012) – founder of Astro-Foil (Aust) P/L & AIRCELL, sold to Kingspan Insulation

*Australian Aluminium Council

Intended readers

Persons directly related to the residential building energy efficiency industry, which includes insulation contractors, manufacturers, energy raters, energy efficiency consultants and certifiers.

Academic and educational institutions, lecturers and heads of architectural and building design departments.

Regulatory bodies at federal and state levels, which entails state building control departments working collectively through the federal ABCB (Building Codes Board) under the COAG states-based framework.

Investigative journalists within print and on-line media, and any interested members of the public.

OVERVIEW

This Timeline attempts to present an extensive historic record of significant events and reports regarding the control of thermal environments using insulation materials, and the inevitable contest between competing commercial vested interests and **the persistent pattern** which appears to 'capture' government decision making, policy formulation and ultimately enforceable building regulations.

All regulations are premised on *public net benefit*, and the public interest should always come before commercial self-interest. The public servants who formulate such policies, in consultation with 'stakeholders', then advise relevant Ministers. However, 'the public' are seldom considered and often neglected as a 'stakeholder'. Stakeholders are invariably powerful business groups who dominate decision making and put business ahead of the public interest. There is not a consumer on any board, committee or anything government related.

In some policy forums there are some stakeholder groups who are clearly publicly motivated and their efforts are commendable, but are invariably overridden by the power of commercial interests. Politicians rarely have any capacity to question laws and regulations, and allow the process to be developed by the bureaucracy. But the bureaucracy is permanently 'captured' by commercial interests.

The entire regulatory process is opaque, not transparent, difficult to navigate, and even the most determined perseverance by a member of the public usually fails. This often results in the public left stranded in confusion, anger, and mostly resignation – i.e. that there is no point complaining, and for those who do complain, they are strung along as if their concern is no consequence. In evidence given at the 2015-2018 Senate Inquiry – Non-Conforming Building Products, it was openly stated that a regulation is often written 'to a recipe', i.e. that the regulation is *intended not to be understood*.

Australian Standards are referenced frequently in regulations, and they too are commonly impossible to navigate and public participation in developing standards is close to a complete waste of time, because Industry who write standards most certainly don't want the public involved, and secondly the public are deliberately left ignorant about everything in building. Occasionally the Consumers Federation of Australia (CFA) sits on Australian standards committees, however the CFA does not represent the public interest in relation to standards committees because no there is no public reporting given, and the CFA is an arm of the ACCC, which is part of government.

A clever technique with standards is to write them in a manner that is incomprehensible and thereby neatly renders them incapable of being challenged.

Then we have the entrenched power of the Standards Committee 'Consensus Vote', where the voices of a few dissenting votes are neutralised without any explanation made publicly and transparently available.

For the general public, the 'door' to influence regulations or participate in writing standards is totally shut, a 'closed shop', a club open to big players in industry, and any intrusion or complaint by the public is dealt with by issuing template-like caring replies that *"all issues must be directed through relevant stakeholders*". Stakeholders are not what people perceive them to be. Often the stakeholder you hope will help you does nothing of the sort. It is incredible to discover that even when stakeholders fight amongst themselves within any regulatory type committee, the drama is rarely exposed to the public and magically the strongest horse wins, a horse that always wins in every race, like the race is fixed.

In some situations, a public fight back occurs, as we have seen in Australia driven by a swathe of Inquiries and Royal Commissions, sometimes causing regulations to be better enforced or changed. Vivid evidence of this is brilliantly explained by Royal Commissioner Kenneth Hayne 8 August, 2019 news report (see Timeline) – excerpts, '*Mr Hayne said trust in all sorts of institutions, governmental and private, has been "damaged or destroyed" and painted a picture where the meticulous work of royal commissions contrasted greatly with the*

political process…… "and it would be necessary to reveal more about what the lobbyists and interest groups are telling government,"……with decision-making processes that not only are opaque but also, too often, are seen as skewed, if not captured, by the interests of those large and powerful enough to lobby governments behind closed doors", he said.

As good as this may sound, Mr Hayne exposed some of the problems, but there was no directive for fixing the issues.

Insulation Industry

This Timeline demonstrates the lack of explanation to justify the steady rise in mandatory levels of insulation materials which are intended to provide 'net benefit' to home occupants, materials that while technically meeting the official standards, may not be suitable for the climate they are installed in, or worse, counterproductive.

The public cannot access any independent agency in Australia to give free independent scientifically based advice regarding insulation material performance in differing climates. CSIRO used to have an advice service, but that ceased around 2005. The public are left to navigate a technical and marketing minefield where invariably the big insulation companies making fibrous bulk insulations advise people that bulk insulation materials are suitable in every part of the building in every climatic situation, which is patently absurd in the hot tropics. If you stop to think about wearing a woollen overcoat in hot weather, or layering woollen blankets over car windscreens, this is crazy when reflective foil shields are logically fitted.

In Australia the battle between bulk and reflective insulations has been going on unendingly since 1952, and seems like it will never stop.

Additionally, this Timeline explains the contributing factors for the creation of a second foil insulation association AFICA Inc. in February-March 2019, initially to defend the long-established use of aluminium foil insulations from the abrupt mandating into the building code NCC May 2019 of 'breather membranes' to external walls of residential buildings. Were 'breather membranes' to be extended to all residential roofing (as is indicated in 2019 technical bulletins from the fibreglass insulation industry), then the total destruction of the foil insulation industry would occur.

The overarching purpose of the new foil association AFICA is to defend and promote the unique thermal capabilities of aluminium foil insulations in reducing the effects of increasing levels of solar radiation and the consequent increasing energy required for cooling and heating in residential as well as industrial and commercial buildings. Details of a pre-existing foil association AFIA, of which the writer was a founding member until February 2019, are explained in the Timeline.

Many reports revealed in this Timeline have been ignored by the ABCB when framing the Building Code of Australia (BCA) 2003 Residential Energy Efficiency Provisions, and beyond. Significant references are made to the writer Tim Renouf due to his personal involvement in many of the listed Timeline issues. Some original source documents and references do not have direct web links, however pdf file copies can be requested and sent out from AFICA.

References made to the brand name 'Sisalation' are impossible to avoid because Sisalation is the most commonly used and interchangeable word that people use for reflective insulations, which is well demonstrated in the history of the development of aluminium foil insulation.

References to Dr Richard Aynsley are extensive throughout the Timeline, and expanded CV details covering academic and professional history are in APPENDIX 2, at the end of the document.

This Timeline information reveals that there has been some physical experimental thermal testing of foil insulations for extended duration in both winter and summer conditions in Australia, but not so for bulk insulations, except notably with an AHRC federal funding project in 1981 in Queensland when bulk and foil insulations were tested separately in ceilings of housing units (see Timeline).

When laws mandate the use of insulating materials to reduce energy usage and greenhouse gas emissions, such laws (like all laws) are meant to be *'evidence-based'*, and provide a *'public net benefit'*.

Insulation materials are affected by many environmental factors, and it follows that regulators must give a direction that any referenced standards be constructed in a manner which requires that thermal performance methods and procedures 'reflect as accurately as possible the performance encountered within buildings'. These *lighthouse* guiding words were in the first insulation standard 2002, and then deliberately removed during the major revision of the central insulation standard published December 2018, a standard that itself is substantially incomprehensible with no explanatory notes stranding the reader in complete ignorance.

The Insulation Industry has its power centred around the relevant Standards Committee BD-58 which in turn influences the national residential energy efficiency regulations, which self-evidently facilitate the sale of ever increasing amounts of bulk insulation materials (think "more is better") via the steady rise in house energy star ratings since being introduced into the BCA in 2003. All this has happened without appropriate real house validation testing, and all regulatory decisions are left basically to computer modelling.

The Australian Building Codes Board (ABCB) make claims they are independent of Standards Australia, which is completely untrue when they hold a voting seat on the insulation Standards Committee BD-58. The ABCB work extremely closely referencing numerous standards for application across a vast range of industries.

In this Timeline, frequent referencing is made to Standards Committee BD-58, and is done so because of the persistent refusal by Standards Australia to be open and transparent with the public about how the individual sub-committees arrive at their decisions.

Summary

The primary reason for this Timeline is to unearth a lost history and compensate for what is lacking, unknown, forgotten or wilfully ignored in the construction of the entire suite of insulation standards. It is important to note that insulation product performance includes thermal, vapour movement, waterproofing and fire resistance.

AFICA encourages the re-examination of the history of thermal insulation in building energy efficiency, and to question the general dominant belief that high mass and high material 'R-values' are thermally beneficial in building design, in light of the broad sweep of climatic variation across Australia and that 50degC temperatures are predicted to become more frequent, as well as the pattern of condensation aligning with increasing levels of insulation and air tightness of buildings since 2004.

AFICA believes that it is in the national and public interest that there be an urgent independent review of the suite of insulation standards and the overarching NCC building energy efficiency regulations, to be undertaken in accordance with recommendations from the '2010 Senate Inquiry – Home Insulation Program' (see Timeline) and, immediately undertaking condensation and mould research in the Australian context as recommended by the '2016 Condensation Scoping Study' (see Timeline).

"If you construct a model on biased and false assumptions then feed in the 'right' data and you can achieve whatever result you want" (attribution unknown).

TIMELINE

"Repetition does not transform a lie into a truth" - F.D. Roosevelt

(sections marked COMMENT are observations by the writer, with emphasis in red)

1945 – 1954 USA investigation into thermal conductance of reflective airspaces

1954 - "The Thermal Insulating Value of Airspaces"
Division of Housing Research, US Dept of Commerce
Housing Research Paper 32 – 1954 (H.E. Robinson & F.J.Powlitch) - commonly abbreviated to 'HR-32'
https://archive.org/details/thermalinsulatin3030robi

This publication is the foundational historical text for the thermal testing of foil insulation laminates in the vertical, horizontal and 45deg planes, with variable air speeds. This US research report was the technical basis for the creation of reflective foil insulations across the world.

INTRODUCTION (opening extracts)

In 1945, at the request of the Federal Public Housing Authority, the National Bureau of Standards reviewed published data on the thermal conductance of reflective and non-reflective air spaces and submitted a summary of representative values. These served as a basis for FPHA Bulletin No.19 "Reflective Insulation", issued in 1945 and were used for reflective insulations in Federal Housing Administration Technical Circular No.7 "Calculation of Section Heat Transmission Coefficients", revised in January 1947.

It was recognized in 1945 that the increased availability of aluminium after the war would lead to greater utilization of aluminium foil and reflective surfaces to form thermally insulating air spaces in buildings. However, the review referred to indicated that the available published data were limited and incomplete in regard to total heat transfer coefficients for air spaces of various emissivity's and with various orientations and directions of heat flow, and for the range of air space thickness, temperature difference, and mean temperature encountered in building insulation service.

The total heat flow across a plane is the result of heat flow by radiation, and heat flow by convection and conduction, between its facing surfaces……..

Accordingly, at the request of the Housing and Home Finance Agency, and with its financial support, an apparatus of the guarded hot box type was constructed during 1948, suitable for the purposes of determining the heat transfer coefficients of air spaces of the kind used in buildings. After use for other measurements desired by the supporting agency, the apparatus became available in 1950 for conducting the extensive series of tests required for the above purpose, the results of which are summarized in this report.

1952 – Sale of the first roll of 'Sisalation' foil insulation in Australia

The story of foil insulation in Australia begins with H.E.Renouf (Ted Renouf, the father of Tim Renouf) when he started his career as a salesman for Sisalkraft Australia (owned by St.Regis Sisalkraft USA), in a branch office in North Melbourne in the early 1950's. Sisalkraft sold bitumen laminated paper to the packaging and building industry and as a waterproofing material (sarking) under sheet and tiled roofs. In 1952 the head office in Sydney sent to Melbourne, a roll of a new type of sarking-type material with aluminium foil faced on both sides.

Upon seeing the roll, Ted's curiosity was ignited and he sought permission to investigate what it was. Ted approached the CSIRO at the Division of Building Research in Highett, Melbourne where Dr. Roy Muncey

confirmed that aluminium foil had in fact remarkable insulating properties previously not seen in Australia. At that time there was only one form of insulation on the market, a fibrous bulk insulation called Rockwool, a product made from blown melted rock.

Dr Muncey opened a reference from the USA quoting a Professor Wilkes, and confirmed that one layer of aluminium foil, in a ceiling with a 100mm downward facing airspace, had the equivalent thermal resistance (R-value) *heat flow down* to approximately 100mm (4 inches) rockwool fibre insulation. But the same foil airspace *heat flow up* was equal to approximately one third to one half of the *heat flow down* value, i.e. horizontal foil had much greater thermal resistance in summer than winter. (However, in walls, vertical foil achieved maximum resistance with minimum 20mm adjoining airspaces and gave the same R-value sideways - *heat flow in or out,* summer and winter – and this was equivalent to approximately 50mm of rockwool).

The fundamental thermal properties of foil were also identified as having approximately 95% reflectivity against radiation, and simultaneously the opposite foil side having an emissivity (i.e. capacity to re-radiate) of approximately 5%, when accompanied by adjoining airspaces.

It was at this CSIRO meeting that Ted Renouf instantly realised that aluminium foil insulation would take off in Australia.

The very first sale of 'sisalation' foil in Australia was made by Ted in September 1952, when he had sent out advertising material to numerous new building projects. One reply came back, it was from St Johns Catholic Church, Maroondah Hwy, Mitcham, a suburb in eastern Melbourne.

The church had a Nissan-Hut style curved metal roof (post WW2) with a narrow cavity space. The only insulation product on the market in 1952 was Rockwool, and Father Gerard Coghlan was about to use it, but saw the Sisalkraft advertising and inquired whereupon Ted convinced him of the significant and unique thermal benefits of the foil product under hot summer conditions. After the installation, the church reported great results for summer comfort. Had Rockwool been used Ted knew what would have happened – the building would have got hot, as explained in further sections of this Timeline.

Rapid sales of the brand name foil 'sisalation' followed and spread across Victoria by the marketing drive of Ted Renouf, which then expanded interstate.

1961 (July) – Formation of RENHURST INDUSTRIES P/L

Following the astonishing success of 'sisalation' foil sales in Victoria and interstate, Ted Renouf resigned from Sisalkraft and created (with partner Bill Broadhurst) a new foil laminating company, Renhurst Industries based in south-east Melbourne, marketing the well known brand name RENFOIL. Renhurst was sold in 1969 to the paper company Reed Consolidated (UK), who subsequently sold the company to James Hardie, who in 1986 sold it to ACI Fibre-Glass.

ACI had acquired the foil laminating plant of St Regis a few years earlier and saw an opportunity to eliminate a competitor and secure majority market share of foil insulation in Australia. In 1986, ACI closed down the RENFOIL brand completely so thereby 'sisalation' became the dominant foil insulation brand name across Australia.

1964 – "The effect of dust on the efficacy of reflective metal foil used as roof / ceiling insulation" (F.J.Lotz) CSIR Report 212, Pretoria, South Africa
https://www.afica.org.au/wp-content/uploads/2020/09/CSIR-South-Africa-The-Effect-of-Dust-on-Reflective-Foil-LOTZ-1964.pdf

The most significant historical report on dust impact on reflective foil insulations. It concluded that double-sided *foil "laid in direct contact with ceilings is soon rendered ineffective if dust settles on it".* However, if laid across tops of ceiling joists, "*in such a manner that both surfaces face airspaces, the effect of dust on its upper surface is relatively small".*

In other words, downward foil surfaces function continuously for low emittance of radiation (approx. 3%) and are largely unaffected by dust, while upward reflective surfaces (approx. 97%) in roof cavities will be steadily impacted by dust, but which is of little detriment to overall 'summer' thermal performance.

The bulk insulation industry across the world, historically, has always claimed that foil doesn't work when it gets dust on it. That is completely false, when a downward foil airspace exists.

1968-69 – "Field test of Sisalation Aluminium Foil Insulation" - St.Regis-ACI (F.Richards) 1971
https://www.afica.org.au/wp-content/uploads/2019/11/St.Regis-ACI-Field-Test-of-Sisalation-Aluminium-Foil-Insulation-1968-69.pdf
Foil sarking testing undertaken in Strathfield Sydney, for an existing unsarked tile roof, followed by installation of foil sarking, which proved the summer thermal benefits in all residential roofs. Of particular interest was the substantial reduction in air temperature surrounding airconditioning ductwork, causing a considerable reduction in the running costs of airconditioning equipment.

This is the single most significant thermal testing of foil sarking ever undertaken in Australia.

1969 – "Reflective Insulation and the Control of Thermal Environments" – St-Regis-ACI (D.Hassall) 1977 (metric version)
The most definitive theoretical textbook document regarding reflective foil insulations, in Australia.
https://www.afica.org.au/wp-content/uploads/2019/11/Reflective-Insulations-Control-of-Thermal-EnvironmentsHassall-ACI-1977-Metric-Edition-Imperial-Edition-1969.pdf

Forward (by Henry J Cowen, Prof of Architectural Sciences)
"*Architects and engineers are frequently inconvenienced by the gap between the limited technical data supplied by trade catalogues, and the text-books which cover the general theory…..this metric edition should prove to be an extremely valuable aid to designers and students….in the Australian Construction Industry"*

Footnote: Emeritus Prof Henry Cowen AO retired in September 2006 as editor of ARS 'Architectural Science Review', the highest publication body to have architectural scientific papers peer reviewed in Australia. http://sydney.edu.au/news/architecture/295.html?eventid=1454

Brief extracts:

4.25 Endorsement of Reflective Insulation (pg. 25):
"The benefit of reflective insulation has been acknowledged by both the Commonwealth Experimental Station, Sydney, and the CSIRO Division of Building Research, Melbourne, who have acknowledged that in resisting the downward flow of heat in summer, a 100mm airspace with a reflective surface on one side, is equivalent to 50mm of mineral wool".

5.7 Vapour Barriers (pg 26)
"One solution to the condensation problem is to include a vapour barrier to prevent water vapour reaching any surface which is cold enough to cause condensation. The vapour barrier should be placed on the warm side of the structure – in order to keep its temperature above the dew point". "Aluminium foil laminated to paper…. is one of the most effective and widely used vapour barriers (and) it can act as thermal insulation, either in the roof, wall or floor of a building".

Read in conjunction with "Timeline - Concluding Comments".

1972 (August) – "Insulation in the Tropics" & "Principles of Reflective Insulations"
Technical Data – St.Regis-ACI (reprinted 1972, supercedes 1967)
https://www.afica.org.au/pdf/St%20Regis-ACI%20%20Technical%20Data%201972%20-%20Insulation%20in%20the%20Tropics%20&%20Principles%20of%20Reflective%20Insulations%20.pdf

This is an extraordinary historical document and a perfect introduction to understanding radiation impact striking the earth, and the development and properties of reflective aluminium foil insulating materials.

Selected extracts:

Principles of Reflective Insulations
"There are basically two types of insulation (a) solid and (b) reflective…..the effectiveness of a bright metallic surface for retarding heat transfer was well known to physicists early last century. The calorimetric experiments of such famous scientists as Rumford and Joule were usually conducted in polished metal containers so that the rate of heat transfer….could be reduced as much as possible.
*In **1878** Pecelet carried out experiments showing the excellent insulating value of multiple layers of tin-coated steel separated by definite air spaces. Dewer in **1892** invented the Dewer Flask which is the basis of the common Thermos Flask…..*
*During the following years occasional references to the insulating effect of bright metallic surfaces were made but there was practically no commercial use of this type of insulation, except that of the Thermos Flask, until **1925**.*
At that time Schmidt and Dykerhoff filed patents in Germany for the use of a reflective surface as insulation.
They experimented with extremely thin aluminium foil…..
The theory connected with the functioning of reflective insulation is based on principles which are much more complex than those which apply to solid insulations. However, since they are principles which mainly concern radiant heat, the result is an insulation which is perculiarly suitable for the tropics where virtually all heat gain is by radiant means".

1975 (October) – "Submission to Government: Domestic Insulation Standards, Improved Comfort Levels, Potential Energy Savings, Mandatory Domestic Insulation"
Author: Mineral Wool Manufacturers' Association of Australia (370 St Kilda Rd, Melbourne)
https://www.concertinafoilbatts.com/report.html

Quotes:
The Middle East Oil Crisis 1973 "*brought the matter of energy resources into sharp focus, and that Australia could not be complacent."*
"….government sources believe that only 5% of all Australian homes are insulated…."
"This document deals primarily with insulation as it affects energy usage for winter heating"
Research is planned to provide a further paper on summer and hot climate domestic cooling"
"The purpose of this document is to show that introduction of mandatory insulation standards would be strongly in the national interest, with any benefit to the insulation industry being irrelevant to the central issue"

Recommended Insulation Requirements (for ceilings) pg 10
Adelaide – 50mm (2")
Canberra – 100mm (4")
Sydney, Melbourne, Hobart – 75mm (3")
(NB: 1975 R-value equivalents **100mm=R2.0, 75mm=R1.5, 50mm=R1.0)**

COMMENT
Comparing the 1975 insulation recommendations, how in 2019 does the fibreglass insulation industry (ICANZ) possibly explain the justification for the steady rise in the mandatory Building Code 'House Energy Star ratings' to a 6 Star level in 2010, resulting in roof-ceiling insulation requiring *R5* & *R6* bulk insulation batts?

The quote above "any benefit to the insulation industry being irrelevant to the central issue" is ironic. Does the fibreglass insulation industry today in 2019 seriously expect the public to believe that R5, R6, R7 batts are justified in roofs, and that their industry isn't interested in any commercial benefit to themselves?

Add to this the persistent scientific theme running through the nationally imposed insulation regulations but never explained, is 'diminishing returns', and how much insulation is needed? The first amount of insulation does the majority of the insulating, and additional amounts providing rapidly diminishing benefit, and articulated in 1981 & 1991 CSIRO technical bulletins, explained in further sections of the Timeline.

1978 – Formation of RIMA 'Reflective Insulation Manufacturers Association' USA
https://www.rimainternational.org/about/history/

The creation of this organization lead to it becoming known today as "RIMA International", which holds meetings of reflective foil manufacturers around the world. It is worth reading about why RIMA came into existence and to meaning around the 'R-value Rule', a rule that still governs the way all insulation products and radiant barriers are packaged, tested and sold.

AFICA Inc. communicates with RIMA International.

ORNL - Oak Ridge National Laboratories USA
RIMA has connections with ORNL Oak Ridge National Laboratories, Tennessee, USA.
ORNL has been significant in the development of Climate Simulation measurement for thermal performance of building systems and insulation materials, and is cited in many technical papers.
(see Timeline references to ORNL)
Footnote: ORNL commenced as a 100 square mile facility built in 1943, as part of the 'Manhattan Project', the development of the Atomic Bomb. It's history is fascinating:
https://www.ornl.gov/content/solving-big-problems
https://www.osti.gov/opennet/manhattan-project-history/publications/SwordstoPlowshares-AShortHistoryofORNL.pdf

1981 (May) – "Insulating Your Ceiling"
CSIRO Division of Building Research – Sheet No. 10-20

Topic sub-headings
What types of thermal Insulation are there?
What are they made from?
How are they installed ?
What is required for good performance?
Are there any fire hazards?
Are there any health risks?
How much should I use?
Which one is the best?
What else?

How much should I use?

"For batts and loose fill this Division suggests using an amount that will provide a thermal resistance expressed as 'R2'. For loose-fill materials, that is 100mm or the depth of ceiling joists, whichever is the lesser. This should provide a thermal resistance in excess of 'R2' unless unusually small ceiling joists are used.
The recommendation can be justified on economic grounds after consideration of several factors such as future fuel costs, interest rates, and marketing factors."

COMMENT

Read this advice of R2 ceiling insulation, in conjunction with CSIRO advice given in 1991 (September). Further reinforcement is found from CSIRO publication "REBUILD", April-June 1981, page 4: '*Insulation rated R2 in the ceiling will reduce the heating load by about 30%. Increasing this to R4 will only reduce the heating load by a further 2% (i.e. to 32%)*'. This is the principle of 'diminishing benefits' which permeates the Timeline.

1981 - AHRC Project 58: "The Thermal Performance of Housing Units in Queensland (Phase 1) Summer and winter thermal performance of ceiling insulation"

By: Univ. Melbourne, Dept Architecture
Research Funding: Australian Housing Research Council (AHRC) - Dept of Housing, ACT.
Research Team: A. Coldicutt(Leader), T.Isaacs,T.Williamson, S.Coldicutt, E.Coldicutt. F.Moshini
Project Committee included a member of CSIRO Division of Building Research.
https://catalogue.nla.gov.au/Record/1402064

The research project examined ceiling insulation options in housing units across four locations in Queensland.
***Brisbane** – BV house, sliding aluminium windows, suspended timber framed floor*
***Longreach** – Duplex unit, weatherboard, louvre windows, suspended timber framed floor*
***Rockhampton** - BV house, sliding aluminium windows, suspended timber framed floor*
***Townsville** – High-set house with variety of windows and high ventilation rates, weatherboard (+Low-set)*

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

Report extracts:
(NB: RFL = Reflective Foil Laminate)

1.1 *Recommendations*
Recommendations are for houses of similar type and similar climatic conditions to those studied in Brisbane, Longreach, Rockhampton and Townsville.

1.1.2 *Use of reflective foil laminate for the ceiling of non-airconditioned houses and as a minimum for the walls and ceilings of airconditioned houses.*

1.2 *User behaviour*
…..common Queenland window use pattern in hot weather appears to be to leave the windows open all the time except for security…..For air movement, fans should be used.

1.2 *Outline of Research*
Thermal performance was monitored in the unoccupied state. Full records of internal and external conditions were made for a week or more in summer.

9.1.2 *Types of insulation*
In this study two ceiling insulation 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…….

The RFL ceiling insulation has a particular advantage for summer performance in hot climates….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 heat flow much less e.g. the building is cooling down at night.

13.1 *Conclusions and Recommendations – Introduction*

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 other: for example, mineral wool insulation greatly improves daytime performance in summer, but keeps houses hotter on summer nights.

Appendix 2: A2.10, 2.11, 2.13 - ***Effect of Insulation on Thermal Performance***

……Reflective foil laminate (RFL) over the ceiling was the first potential improvement studied, It is a particularly 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.

……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 one third & one half…..

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

Appendix 2.14 *Recommendation for base case for each location*

……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.

COMMENTS & SUMMARY

The Report concluded that for non air-conditioned houses, reflective foil insulation should be used in all four locations, and fibre-based insulation should not be used. If these same test houses are air-conditioned, reflective foil at least should be used as a minimum.

The simple physics of all bulk insulations is that they have greater resistance to *heat flow up* than foils, causing houses to stay hotter longer by trapping in the often difficult to ventilate 'stagnant heat zone' between the top of the doors and windows, and the ceiling itself. Just as bulk insulation traps in heat generated in winter, it does this also very successfully in hot climates (see Timeline 2003 BCA Code, energy efficiency R-value tables).

Foil laminates on the other hand, stop heat penetration successfully during the day and release any accumulated heat beneath the ceiling during night time because of the foil's inherently lower resistance to *heat flow up,* compared to bulk insulation.

The 1981 report and the fundamental issue of building cool down, was ignored by the ABCB, Standards Australia and fibreglass association FARIMA (ICANZ), when the first insulation standard was evolving 1998-2002. The insulation resistances for bulk insulations are based soley on a four hour laboratory static test 'Steady State' condition for 'conducted' heat (refer 2002 Timeline).

1983 – Creation of AS 2627 Part 1 (1983)

"Thermal Insulation of Roof/Ceiling in Dwellings Which Require Heating"

The first insulation guide of recommended R value levels of insulation to be added to roof/ceilings, for locations across Australia requiring winter heating. This standard was radically revised in 1993 to include cooling.

Refer to Timeline 1993.

1985 (July) – "Thermal Resistance Measurements on Brick Veneer Walls Insulated with Reflective Foil" based on CSIRO (DBR) Internal Report No. 84/20

'AIRAH Journal' July 1985 Vol 39, No.7

Author: Clarke R. and O'Brien L. (CSIRO – Division of Building Research, Highett, Melbourne)

Contributory funding by: Aluminium Development Council (ADC)

This report describes laboratory and field experiments to determine the thermal resistance of brick veneer walls for winter conditions in temperate Australia using reflective foil, double-sided bright foil, as well as double-sided antiglare application.

Extracts from AIRAH Journal: pgs. 19-22

Conclusions (pg 21)

The key element of this study has been the measurement under winter conditions of the thermal resistance of a number of brick veneer walls over a wide range of cavity air speeds, the results of which are shown in Figure 4. In fact, air speeds measured in the field were quite low, averaging 0.06 m/sec as shown in Table 1. The thermal resistance values at about this rate of ventilation are therefore of greatest practical significance. These, as Table 2 shows, are in the region of 1.5 m2K/W (R1.5) for insulated walls where insulation standards are good, but may be a little higher or lower depending on other conditions……

What has the greatest bearing on the actual thermal resistance is the state of the reflective foil insulation in terms of its surface emittance, condition and fixing detail and there is cause for concern about installation standards in the field. It may be optimistic to assume that the foil curtain will generally be neat, flat, complete and without penetrations. At the same time, local damage in a few stud spaces will have little overall significance.

The thermal resistance of brick veneer walls depends also on the temperature difference at the time and will vary over the heating hours……

TABLE 2:

Estimated thermal resistance of typical brick veneer walls with bright and anti-glare reflective foil insulation (RFI), and without insulation, based on experimental data from the guarded hot box with a ventilation rate of 0.06 m/s in the wall cavity and a good standard of installation.

Air to air Temperature Difference (K)	*Overall thermal resistance (m2K/W) configuration for the given insulation*		
	BRIGHT RFI	*ANTIGLARE RFI*	*NO RFI*
6	*1.7*	*1.5*	*0.5*
9	*1.5*	*1.4*	*0.5*
12	*1.4*	*1.3*	*0.5*
18	*1.3*	*1.2*	*0.5*

COMMENT

This research was quoted in the June 1986 submission by the Aluminium Development Council to Standards Australia (see Timeline below).

Table 2 results above are presenting 'Total R-values', verified by actual physical measurement for a range of temperature differences, and were in alignment with the work first undertaken in USA 1954 Robinson & Powlitch.

6K temperature difference is representative of Melbourne, where winter outdoor average, April – October12degC is 12degC, and internal temperature setting is 18degC (recognised for energy efficiency). Therefore 18 – 12 = 6K. The lower the K, the higher the Total R value.

Therefore, for locations with milder winters than Melbourne, the Total R value of foil insulation in walls will rise. This means that with vast regions of Australia having a 6K temperature difference between indoor and outdoor (think winter and summer), the simple application in BV walls of anti-glare double-sided foil producing conservatively Total R1.5 has considerable thermal application.

Note: Foil insulation has been physically tested in Australia in walls, under winter conditions (CSIRO 1985) and in roofs, under summer conditions (St Regis-ACI 1968-69). To the best of the writer's knowledge, up until around 2010 there has been no equivalent physical long duration hot climate in-situ testing using bulk insulations alone in either roof-ceilings or walls of residential buildings.

1986 (April) – Advice to Standards Committee BD-58
'Recommendations For Summer Cooling' by Mr. Tony Isaacs
This is presented in the public interest.

Selected quotations:
Introduction
The ultimate aim of BD-58 is to produce a code for the design, construction, and operation of domestic buildings which would enable the user to minimize building energy use and enhance thermal comfort without imposing undue cost burdens. The insulation standards: ceiling over heated areas, walls, etc. represent incremental steps towards this ultimate aim. In the interim they provide home builders, designers, and owners with quality information about the most important element of "low (heating) energy" building design based on the best information available to the committee.

The consideration of a 'hot season performance standard' poses several problems for the committee as the approach used in previous standards is no longer suitable. It would be impractical to draft a standard on hot season performance which gave advice solely on the thermal resistance of opaque building elements. Moreover, there is not sufficient data available to enable the Heat Flow Modulus concepts used in AS 2627 (1983) to be extended to Cooling Numbers. Consequently, the consideration of a 'hot season performance standard' puts the design code back on the agenda……

Difficulties with design codes
were……(iii) it was not clear how the conflicting requirements of hot and cold season performance could be reconciled. The committee therefore looked to future research to provide some of the answers to these problems.

Research projects offering some solution
*references made to GMI scheme simulations using ZSTEP
……The AHRC projects completed by the Coldicutts have similarly provided much useful information about the thermal performance of buildings and occupant behaviour and attitudes. Of particular interest is Project 58 studying the thermal performance of public housing in Brisbane, Rockhampton, Longreach, and Townsville….examines the hot season performance of dwellings…The principal problem encountered in this project was the task of reconciling the conflicting requirements of hot and cool season and night and day time performance when framing the recommendations…

The way ahead
At recent meetings I have suggested various approaches to the problem only to find after examining committee records that these have already been tried and found wanting.
…the design guide requires considerable further research.
The committee could produce a design guide for locations which require year round refrigerative cooling….
Buildings in hot climates without significant cold seasons which are passively cooled could be simply covered by a requirement reflective foil in the ceilings, advice with regard to shading and surface colour of external elements, the use of ventilation…..

COMMENT

It is good to read Mr Isaacs calling for 'more research' in this 1986 report. Mr Isaacs also was a team member of Project 58 referred to, which was ceiling insulation research in 1981 across Queensland (see Timeline).

This Timeline illustrates a rather exhaustive pattern of requests for government funding for research, when the evolving building energy efficiency regulations were systematically failing, because there was no 'real world' 'real house' testing undertaken, with rare exception.

Mr Isaacs was the primary consultant justifying the introduction of 5 Star levels of insulation into the BCA 2005, and has been an openly declared consultant for the fibreglass industry for a number of years.
It would be interesting to ask what Mr. Isaacs' views are today in 2019 about the need for a 'hot season performance standard', in light of impending 50degC days, and whether reflective aluminium foils have a part to play.

1986 – "Comparison of Evaporative Cooling and Refrigerative Air Conditioning for Dwellings in South Australia"
Author: T. Williamson, S. Coldicutt – Dept Architecture, Univ Adelaide, SA
Funded by: SA State Energy Research Advisory Committee
https://catalogue.nla.gov.au/Record/2052577

Extracts:

1.1 SUMMARY *(pg. 3)*
This study involved the comparison of evaporative and refrigerative air conditioning in dwellings for the range of climates occurring in South Australia, considering different forms of dwelling construction, plant capacities, and modes of plant operation……

1.3 CONCLUSIONS *(pg 5) *last paragraph*
Choice of cooling system has significant implications for decisions regarding construction materials and insulation. With refrigerative cooling, insulation is economically justified on the basis of savings in the total present value of cooling costs in all locations studied except Mt.Gambier. With evaporative cooling, however, insulation and materials have little effect on energy use, and therefore it appears that nowhere in South Australia is bulk insulation or increased thermal mass (brick veneer to brick cavity) economically justified on the basis of savings in evaporative cooling system costs.

6.3 DWELLING CONSTRUCTION *(pg 45-46)*
**Two house construction types were used in the simulations - standard brick veneer and cavity brick, both on concrete.*
**Both fully insulated and poorly insulated, all 4 cases with default RFL foil sarking.*
**RFL foil sarking to tile roofs.*
Brick veneer (fully insulated) = R2.5 bulk in ceiling + RFL foil in cavity (compared to zero ceiling and wall insulation)
Cavity brick (fully insulated) = R2.5 bulk in ceiling + bulk insulation in cavity.

COMMENT

Compare these report findings to the Timeline 1993 'Creation of AS 2627.1', a standard advising on insulation needed for houses based on *whole house central refrigerative cooling*.

A tempting conclusion to draw is that because insulation has far less beneficial impact with evaporative systems (due mainly to the nature of high speed of cooled air distributed), it became vital in order to justify selling bulk insulation, to construct the 2003 national building code and the insulation standards, on the presumption that *all housing to have central refrigerative cooling*. A false and unjust assumption because refrigerative cooling consumes the most cooling energy of all cooling options!

In other words, the BCA-NCC residential building energy efficiency provisions were founded on the perpetual cycle of ever rising insulation levels, i.e. “more is better”.

1986 (June) – Submission - “Thermal Insulation of Dwelling Walls – Heat Loss Situation”

Author: Aluminium Development Council (ADC)

To: Standards Association of Australia, Sub-Committee BD 58/8 Working Group - Walls

*Extracts are presented here in the public interest, and in accordance with 2018 ‘Governance Review’ Report. Opening sections shown here. Technical analysis followed later in the report.

SCOPE

In this submission a comparison has been made of the benefits to be gained by increasing the Thermal Resistance of a dwelling wall by firstly adding insulation R value and secondly by adding R value 1.5. As prescribed, conditions studied were those basically applicable to:-

Melbourne

Heating Season

Brick Veneer Wall

(with Victorian state consideration)

CONCLUSION

After consideration of the respective benefits:-

a) *From a home owners economic viewpoint, clearly an added R of 1.0 is to be preferred*
b) *From a state (or national) energy conservation viewpoint, adding insulation of R value beyond 1.0 cannot be justified.*

RECOMMENDATION

The Aluminium Development Council respectively submits that for Melbourne and for areas of parallel or milder winter climatic conditions that an added R value 1.0 be adopted as a standard for dwellings of Brick Veneer Wall construction.

Areas throughout Australia of differing climates and dwellings with other wall constructions should be separately assessed and insulation standards set accordingly.

INTRODUCTION TO STUDY

Past publications and previous submissions to the working have clearly indicated the presence of the “diminishing return principle” when the potential benefits of increasing dwelling wall (and ceiling) Thermal Resistance are assessed. Among these works are:-

1977 D.White, 1977 E.R.Ballantyne & L.O’Brien, 29 /9/1983 – 10/1985 A. Delsante, 10/12/1985 H.Watt

This submission examines in detail from both economic and energy conservation viewpoint the benefits that may be expected when wall Thermal Resistance is increased by:

a) *R of 1.0 - Reflective Foil*
b) *R of 1.5 - Bulk Insulation*

Particularly the significance of the “diminishing returns” is examined by comparing the differential benefits.

__end of ADC submission__

COMMENT

This submission was part of discussions considering regulatory minimum levels of insulation across Australia. It was earlier identified in 1984 & 1985 CSIRO research into the measured Total R value of brick veneer walls with plain and anti-glare foil under winter conditions (funded by the Aluminium Development Council), that for Melbourne conditions, anti-glare foil produced an ‘added value’ R1.0, the uninsulated wall value was R0.5, and the wall in totality was Total R1.5.

This submission sets the scene, for what unfolded in the Victorian minimum thermal regulations in 1991.

1986 (July) – Sale of RENHURST Industries (James Hardie) to ACI Insulation

Renhurst Industries developed and promoted the substantial body of science regarding foil insulation, covering thermal, structural composition and condensation control issues. Other independent foil insulation companies, such as St.Regis-ACI, had also expanded the sales of reflective insulations. By 1986 Renhurst had secured 55% market share of foil insulation in Australia, selling the widely known brand RENFOIL.

The acquisition of the RENFOIL name by ACI was assumed to shift the 55% market share to them, however this did not happen and back-fired badly, because specifiers' loyalty to the RENFOIL brand name had been very strong.

The purpose of this Timeline story is to assist the reader in understanding that the Renhurst sale had profound implications for what happened next in 1991, and beyond as the battle between bulk and foil insulations continued.

1987 (May) – REPORT on Condensation Problems at GOVE for NABALCO Pty Ltd

Location: Gove Peninsula, Northern Territory
Author: Macks and Robinson P/L – Architects (Townsville), and Blain Bremmer and Williams P/L – Engineers (Brisbane)
Site description: Mining township including approximately 500 houses and plant amenities building site

A. Brief and Summary

This report is in response to a request from Nabalco P/L to investigate nominated buildings at Gove and to prepare recommendations to enable the company to carry out works on the buildings which overcome the condensation problems which presently exist.

A.7. Generalised Assessment

…..in short, our investigations revealed that all of the condensation problems inspected are considered to be a result of a breakdown of, or an absence of an effectively sealed vapour barrier and insulation layer surrounding the air conditioned space, allowing access of high humidity external air to cool surfaces of ducts or other building elements with consequent condensation…..

Solutions proposed consist of either, reinstatement or provision of a sealed envelope or, where this is not considered practical, up-grading of insulation to cold elements with associated vapour barrier.

C. APPENDICES

** summary – total repair costs = $1,990,000 to $2,400,000

COMMENTS

This is one of the early high profile and well known condensation damage case stories. Airconditioned spaces are the driving force that dramatically increase the risks for formation of condensation, as all heat moves from 'from warm to cold'.
Condensation risks in hot-humid climates of Australia are well covered in the 2016 AIRAH Application Manual, "DA20 – Humid Tropical Air Conditioning" (See Timeline).

1989 (April) - "The summer performance of reflective foil insulation in brick veneer walls and under tile roofs" (DCE Doc 89/14)

Author: R.E. Clarke - CSIRO Division of Building, Construction and Engineering, Highett VIC
Funded by: The Aluminium Development Council
Period of Summer Testing: 1986 & 1987
"Prepared for distribution to project sponsors and assessors, and may not be cited"

The 1989 report was an extension of earlier CSIRO winter testing BV walls undertaken in 1984, by Clarke & O'Brien (CSIRO), and this 1984 testing had little application for summer. Refer Timeline 1985 AIRAH Journal publication.

Distribution List
Aluminium Development Council – 7 persons
L. O'Brien (ex-CSIRO)
H. Batt (ex-Renhurst Industries) *which had been purchased by ACI in 1986
S. Goodacre (ACI Laminates and Coatings)
J. Nash (ex-Caroma Industries) *foil laminators
A. Williams (Monash University)

This report was given to Tim Renouf in the early 1990s by Hilton Batt, who had been the former Technical Manager of Renhurst Industries up until 1986, and had been on the research team (Hilton was also consultant to Wren Industries 1991-2005, as well as to the newly formed foil association AFIA 1996-2005). Hilton gave the report to Tim on the clear understanding that no meaningful conclusions could be drawn from the report because the two years of summer testing were unusually cool, and that "more extensive experimental data" was needed.

Accordingly, no temperature conclusions are revealed here, but here are interesting quotations.

SUMMARY
An experimental brick veneer house has been used to evaluate the performance of reflective foil as a thermal insulation under actual summer conditions in Melbourne. Reflective foil was installed on the outside of the studs in one half of the west wall and under the roof tiles in one half of the roof, creating four zones, which allowed simultaneous measurement and comparison of insulated and uninsulated sections.
CONCLUSIONS
This study has demonstrated the feasibility of a heat flow meter technique for evaluating the thermal performance of building elements in a non-steady-state environment. The plasterboard-based heat flow sensors have proven to be practical to make and install in large numbers and have worked reliably. The use of multiple sensors has been instructive in revealing the considerable spatial variation to be expected over typical walls and ceilings.

COMMENT
The summer foil testing project revealed the feasibility of measuring thermal performance of residential building structures, in non 'steady-state', i.e. which means actual 'dynamic state' real time climatic conditions. This is the very issue that the writer Tim Renouf has been consistently calling for since 1996.

Hilton Batt informed Tim Renouf that during this summer research work Hilton had suggested to one of the Committee team to seize the unique opportunity of using a real tile roof structure to test not just foil sarking under a tile roof, but to include testing of fibreglass batts fitted in the ceiling as well. The Committee member replied, NO. The reader can be left guessing why the answer was NO.

To the best knowledge of the writer, there has never been in Australia, long duration hot climate testing of bulk insulation materials.

1991 Victoria - First mandatory residential insulation regulations in Australia

Following the 1975 submission by the fibreglass industry to government for mandatory domestic insulation (see above), Victoria became the first state to enact compulsory minimum levels of insulation in new housing, presenting two simple options:

Roof-Ceilings = R2.5 bulk insulation
Walls = R1.3 RFL foil wrap, if on concrete slab or timber floor insulated, or R1.5 batts if floor uninsulated

COMMENT

It is staggering to compare the levels of bulk insulation recommended in roof-ceilings in 1991 (R2.5) with 2019 (R5 & R6). Later explanation will illustrate that the entire regulatory system is not backed up by real house thermal testing. The 1991 Victorian legislation triggered the launch of innovative foil insulation materials by Wren Industries (expandable foil), Foil Board (foil faced styrene), and an array of bubble foil laminates in roll form.

1991 (August) – "Thermal Insulation – Installation and Materials"
CSIRO – Division of Building, Construction and Engineering NSB 163
*more detailed than 1981 bulletin, with numerous sub-heading topics

Amount of Insulation

7.01 *The amount of insulation that is economically justifiable depends on the type of construction and local climatic conditions. Money saved by thermal insulation will vary not only with building design and layout but with the lifestyles of the occupants and the pattern of their use of energy. Some people consider that feeling comfortable is more important than saving energy.*

7.02 *The initial insulation added to a surface makes the most significant effect. As extra insulation is added an increasing proportion of the total heat transfer occurs through paths that have not been insulated; doors, windows etc. It is better to consider all of the heat paths in a particular building rather than to insulate one of them heavily.*

7.03 *Benefits are not directly proportional to the R value of the insulation because the surfaces being insulated have an initial thermal resistance. For Australia's temperate coastal regions, insulation with a thermal resistance of 1.5 to 2.0 m2K/W (or R values of 1.5 to 2) would be generally adequate for ceilings. For roof/ceilings in buildings needing significant winter heating, AS 2627 – 1983 gives recommended levels for various locations.*

COMMENT

The principle of 'diminishing benefit' is once again displayed by CSIRO. This advice is also worth comparing to what is stated below in the creation of AS 2627.1 (1993). A substantial proportion of Australia's land mass has no winter heating requirements, yet bulk insulation, historically invented in the northern hemisphere for stopping winter heat loss through ceilings, is permitted by national regulations to be used in roof-ceilings for any climatic conditions across Australia.

1993 – Creation of AS 2627.1(1993) "Thermal Insulation of dwellings – Part 1: Thermal insulation of roof/ceiling and walls in dwellings"

This document was a highly mathematical analysis undertaken by CSIRO Melbourne, to present recommended levels of added insulation for ceilings and walls of dwellings to be heated and cooled, for listed locations across Australia, set out in R0.5 intervals. It evolved from an earlier 1983 standard (see Timeline 1983) based on heating alone.

AS2627(1993) had a highly limiting factor that the document could only be used for houses which were heated and cooled.
Pg. 10 stated:
"it should be noted that the recommended values obtained from columns containing the word 'cooling' may only be used for dwellings for which whole-house (i.e. central) refrigerative cooling is to be used. They shall not be used for dwellings that are to use evaporative cooling."
In other words, AS2627 had a restricted use and could not be used as a reference document for naturally cooled or evaporatively cooled houses.

After its publication, AS 2627.1 was launched in seminars across Australia in 1994 with the lead speaker from FARIMA, the fibreglass and rockwool association.

The seminars distributed a joint Handbook "SAA HB 63-1994" produced by Standards Australia & FARIMA (the fibreglass insulation industry), which had coloured maps state by state of recommended R-values. The Handbook did not declare this strict limitation on the use of the document. The booklet was effectively a sales tool to sell fibreglass batt insulation across Australia, as smoothly as possible.

Just prior to publication AS 2627, it was stopped by a major objection from independent foil insulation manufacturers, who pointed out that 2627 was biased to selling fibre batt type insulations, and that changes must happen to allow the consideration of foil insulations. CSIRO was compelled to introduce an 'equivalence' table Total R-value conversion table to line up against Added R-values, because foil insulations can only be expressed meaningfully in a 'Total R-value'.

The 'comparative - equivalence' table of ADDED & TOTAL R-values revealed:
1.5/1.7, 2.0/2.1, 2.5/2.4, 3.0/2.7, 3.5/2.9, 4.0/3.1

NB: The table is largely illustrating the 'Total' thermal impact of timber framing with changing Material R-value, the thicker the bulk insulation the more the framing affects Total R-value.

During the heating season, it was assumed the mean indoor temperature necessary to provide a satisfactory level of comfort in the heated areas of dwellings, was 18degC.
During the cooling season, the base condition was whole house central refrigerative cooling, and the thermostat setting at 24degC was assumed.
Insulation levels for naturally ventilated houses was not provided as an option.
Incorporating reflective insulations into the mathematics was extremely difficult.

Examples from the table of recommended Additional R-values (roof/ceilings)
(Separated into two columns - Heating / Heating & Cooling)

Melbourne 2.5/3**,** Mildura 2/4, Hamilton 2.5/3, Wodonga 2.5/4, Bairnsdale 2.5/3
Sydney 1.5/3, Wagga Wagga 3/4, Canberra 4/4, Bourke 1.5/4, Newcastle 1.5/2.5, Coffs Harbour 0/2.5
Brisbane 0/2.5, Gladstone 0/2.5, Cairns 0/3, Townsville 0/3.5, Longreach 0/3.5, Birdsville 0/4
Adelaide 2/3, Moomba 0/4, Whyalla 1.5/3.5, Port Lincoln 1.5/3, Renmark 2/4
Darwin 0/4, Katherine 0/4, Tennant Creek 0/4, Alice Springs 1.5/4
Perth 1.5/3, Margaret River 2/3, Kalgoorlie 2/4, Geraldton 0/3.5, Broome 0/4, Fitzroy Crossing 0/4

It's quite astonishing to see the ceiling R-values recommended in 1993 and compare them to R5 and R6 levels to meet the BCA-NCC 6 Star levels of 2010, just seven years later. NB: AS 2627.1 was formally withdrawn in 2007. From start to finish the battle to remove AS 2627 from public use took 10 years.

AS2627(1993) was a flawed Standard, skewed completely towards the promotion of fibre based bulk insulation, and based on a dubious complex mathematical methodology for arriving at the recommended R-values for ceilings, which did not include radiant barrier foil insulations. The best illustration was how AS 2627 ignored the outcomes from the 1981 AHRC Queensland insulation testing project, advising foil instead of bulk insulations (see earlier).

Aided by the brilliant marketing of the AS 2627.1 "Handbook", Councils across Australia routinely referenced AS 2627 selecting the Added R-value for the column for Heating & Cooling alone. This fuelled the sale of fibreglass batts. For example, for all those locations requiring zero or little winter heating, but were hot, then believing R3 – R4 bulk insulation was correct, even if people didn't use airconditioning.

This situation carried on until the final withdrawal of AS 2627 in 2007. This entire time, Standards Australia did not inform the public by special notification that AS 2627 was strictly to be used only for whole-house refrigeratively cooled dwellings. A rather limited proportion of Australian housing.

The following is an academic explanation provided by the foil association's technical adviser, Dr Richard Aynsley to Standards Committee BD-58 in 2002, that AS 2627 had to be revised urgently or suspended.
It is reprinted here because it effectively conveys to the average reader how technically unsound AS 2627 was. AS2627 was an obvious forerunner template which very likely influenced the formulation of the BCA 2003 residential building energy efficiency provisions.

R. Aynsley
Communications to Standards Australia
April 26, 2002

NOTES Re May 1 Meeting and Proposed Working Group to review AS 2627.1

I have been a member of BD 58 committee since the mid-1970s. I would like to continue to receive papers, drafts and participate as best I am able. I still hold a position at James Cook University, and AS2627.1 is of concern to people in the tropics, as well as other parts of Australia. My comments focus on the way AS2627.1 impacts on houses in the tropics.

Considering the aim of the meeting on May 1 "to formulate a terms of reference for revising AS 2627.1" I wish you a very productive meeting and I am sorry I am unable to attend. I offer a few points for consideration below. I am ready to participate in the working group to review the standard and can assist by
** providing results of tests and measurements of heat transfer on buildings, carried out by myself, and others.*
** sharing my knowledge, and that of others from my extensive resources, gained through long term research into tropical architecture and related building science.*
** suggesting ways to deal with insulation performance evaluation, materials and installation in free running buildings.*

*1. AS 2627 has many faults. It **needs to be revised** AND probably suspended until a better version is produced. The changes needed cannot be achieved in one meeting.*

*2. The **meetings should be open** to all who have a genuine reason to attend, such as particular industry representation, expertise in heat transfer, climate, building etc. The representation now is too narrow and restrictive.*

*3. The **consumers** of the insulation products **should be represented** at each standards meeting by an independent person with no commercial interest in any of the related industries.*

*4. AS 2627 is designed for closed buildings - heated and cooled - not free running (refer page 10, AS2627). Considering the Australian government imposed obligation on us to produce energy efficient buildings, yet only make changes which have a cost benefit, **issues relating to insulation in free running (naturally ventilated) buildings must be included in AS 2627**. There is NO doubt they are more energy efficient and have much lower operating costs.*

*5. **Radiant heat** is a major problem in the tropics. This **needs to be addressed** in the standard. Numerous surveys have measured high internal surface temperatures (up to 49 deg C, & 20% of houses measured had ceiling temperatures above 38 deg C, Townsville, 1997- Sariman PhD thesis). The results of a number of international tests have demonstrated the best way to effectively reduce radiant heat from the internal building surfaces is by installing reflective cavities in the roof space, with light coloured roof surfaces and shading to the roof and walls.*

*6. The review committee needs to **review all insulation products** and assemblies, and construction methods in use, or foreshadowed, and address these professionally in the standard according to current best practice in Australia and internationally.*

*7. The review committee needs to **consult widely** so that all material included in the standard is well considered and nothing is omitted. Recent consultation by Australian government bodies concerned with these matters has been far too limited.*

*8. The **reflective foil industry** has many concerns about AS 2627. Their products have been neglected in previous editions. Reflective foil laminates (RFL) have an indispensable role to play in reducing radiant heat in buildings in Australia. Factors affecting reflective foil laminates need to be addressed fully, and separately to resistive products. Products combining RFL and resistive insulations should also be addressed separately.*

*9. **R values - upward and downward** - should remain in the standard. They are required for free running buildings, particularly those in warmer climates R Values for reflective foil laminates should be calculated using validated methods (Robinson et al 1954).*

*10. **Computer simulation software** particularly house energy rating software is still not accurate enough for it to be mandatory. The review committee could establish **criteria** for these in relation to insulation and thermal transfer through buildings.*

*11. All building **simulation software should be verified** against measurements in the field. The recent actions of the Australian Greenhouse Office, various state and local governments have raised the awareness of the public in matters relating to the insulation of their homes and achieving a good home energy rating scheme (HERS) score for their property. If the HERS score does not appear to represent reality then owners may challenge this in court, particularly when expensive property is affected - and they can measure this reality for themselves. The review committee needs to be very **careful in relation to HERS.***

*12. Avoid recommending the inclusion of any clauses which could bring **legal action** against those, such as local government bodies, who innocently reference as mandatory any section of the standard.*

*13. Although not the subject of 2627.1, the **testing and materials and installation** of insulation is of concern to this working group.*

Testing of insulation should reflect the range of temperatures under which the products are operating - and that can be up to 100 deg C (black metal roof in sun) but 70 deg C is accepted practice.

Software in ASTM 1340 could provide a level playing field for evaluating heat transfer (particularly at high temperatures) for both reflective and resistive insulation through roofs with attic spaces. ___End of Aynsley text__

1994 (Dec) – CSR Bradford: Building Design Guide – The Effect of Solar Radiation

*It appears that this CSR technical document has not existed for many years.

Introduction *(pgs 7-9)*

The thermal performance of buildings is affected by a complex relationship between all components of the structure, and the environment.

Some elements of this relationship include:

- *Windows…….*
- *The materials of which the walls are constructed affect not only steady state heat transfer, but also the transient response, of the internal environment, to diurnal external temperature changes. In this respect mass and specific heat are important physical properties.*
- *Ventilation is variable…*
- *Internal temperatures which vary throughout the day and from room to room*
- *During the days, solar radiation produces external temperatures which are higher than ambient "shade" temperature, and which vary around the building envelope in accordance with orientation and exposure to the sun.*

The design guide discusses this complex relationship by analysing two major elements:

- *The effect of insulation on the rate of heat flow and on condensation*
- *The effect of solar radiation*

The Effect of Solar Radiation (pg. 7 very detailed explanation)

"Solar radiation absorbed by a material will cause the material to attain a temperature in excess of that of the air close to it….In practice, walls of dwellings might attain a temperature of 55degC while sunlit, and pitched roofs might heat to about 65degC during hot summer days when the dry bulb temperature of the air about 38degC to 43degC. Thus, the rate of heat into a dwelling which is proportional to the temperature difference prevailing, can be increased several times when walls are sunlit. The principal effects are twofold: firstly, the rate temperatures of internal surfaces will rise, and secondly, heat will be transferred to the air in contact with them."

COMMENT

Here, the fibreglass insulation industry is warning about the importance of radiation levels falling on buildings across Australia, and of the interplay with condensation, and revealing 65degC roof temperatures.

Looking ahead on the Timeline, the major revisions of insulation standards of 4859.1/4859.2 – 2018(materials & calculation), 3999-2015(installation) and 4200-2017(pliable building membranes) did not address the combination issues of condensation and radiant heat flow – in 'Dynamic State'.

1996-2006 – Formation of the first aluminium foil association in Australia, AFIA, and development period for the first unified national insulation standard in 2002, and its subsequent amendment in 2006

SEFIA, the 'Segmented Foil Insulation Association of Australia' was formed in 1996, which in 1998 evolved into AFIA, the Aluminium Foil Insulation Association. The writer Tim Renouf was Secretary & Treasurer for a number of years, and the representative of AFIA on the Standards Committee BD-58 (responsible for insulating material for buildings), from 1998 to approximately 2005.

In 2000, the most crucial moment for the foil insulation industry arrived when AFIA acquired a voting seat on Standards Committee BD-58 after the AAC, the Australian Aluminium Council (former name ADC) ceded its BD-58 vote to AFIA, on the condition that the pursuits for the best interest for aluminium foil were maintained. Rapidly after AFIA was formed, its size grew to 16 members and included even the foil divisions of the three fibreglass insulation companies.

From its inception the foil association had technical support from Hilton Batt (former Technical Manager of Renhurst Industries) and Prof Richard Aynsley (formerly of James Cook Univ, Townsville). Hilton undertook the original dissection of HR-32 USA to better identify its applicability and extrapolation for the launch of innovative new foil insulations in Australia. Hilton's pioneering work enabled another engineer in Melbourne James Fricker to develop the methodology of performing Total R value calculations of reflective airspaces using computer programs, for a variety of emerging foil insulation systems.

The overall goal of AFIA was to represent independent foil insulation manufacturers on Committee BD-58 in order that the highest benefits of foil were being protected as the new unified Australian national insulation standard 2002 evolved, followed by its subsequent Amendment No.1 in 2006. This was a tumultuous period because the fibreglass insulation industry had historic market dominance and needed to control the operations of Standards Committee BD-58, and many unpleasant episodes occurred.

In 1996 SEFIA was formed (followed by its change of name to AFIA in 1998), in order primarily to participate in a collective insulation industry discussion group known as AIMDG (Australian Insulation Manufacturers Discussion Group) which evolved into IMAA (Insulation Manufacturers Association of Australia). This grouping was necessary in order to satisfy government requirements for a 'whole-of-industry' consultative process for the development and implementation of mandatory insulation regulations and standards into the Building Code of Australia (BCA).

The insulation strategy was a component in overall national greenhouse gas abatement policies announced by the Prime Minister's formal announcement in 1997. The announcement made clear that should voluntary insulation measures not be possible within 12 months, then mandatory measures would commence, and these measures then were the sole driver for IMAA to operate, to co-ordinate the whole of the insulation industry into action.

In the first meetings of the AIMDG, there was an admission that it was a remarkable feat for all of the insulation industry to be speaking with one another considering the severity of earlier wars, most notably between the

cellulose insulation industry (ACIMA) and the fibreglass industry (FARIMA), so much so that at an early AIMDG meeting, it was admitted that "guns had to be left at the door".

IMAA comprised fibreglass, polyester, cellulose and foil industries, and the Secretary of IMAA was simultaneously the Secretary of FARIMA (the fibreglass industry). For a number of years the collective group (each group having two voting delegates) held tenuously together as the new standard evolved 1998-2002, and also because IMAA was angling for federal funding contribution towards insulation enforcement strategies.

However, it progressively dawned on all IMMA members that the joint IMAA-FARIMA Secretary was impossibly compromised, i.e. he was serving two masters and FARIMA always had the information advantage over the other IMAA members. It was ultimately naïve of other members (including the writer) not to have seen an inevitable crisis coming.

1997 (October) – "Computational Analysis of Reflective Airspaces"
Publisher: 'AIRAH Journal' October 1997
Author: James M Fricker (B Mech E, M AIRAH) - Enersonics P/L, (Melbourne, Victoria)
http://passivehouse.com.au/cms/tinymce/filemanager/library/Reflective_Air_Spaces_JMF.pdf

Quotations:
Introduction - *"This paper will firstly discuss general principles of reflective insulating cavities, then discuss their application as an adjunct to conventional insulation and building materials"*.

Summary comment
This paper was the first time in Australia that using fast and friendly personal computers, the work of Robinson & Powlitch (USA 1954 HR-32) was extended to allow thermal performance evaluation of new building sections incorporating reflective insulation.

James Fricker has undertaken the majority of reflective foil Total R-value computations in Australia, since 1992.

1999 – AITA "Thermal Design - Passive Approach: mass, sol-air temperature control" (TR5001:03)
Author: Richard Aynsley, Australian Institute of Tropical Architecture, James Cook Univ, QLD

Introduction
With growing concerns on energy costs and efficiency, significant efforts have been made to develop techniques for the design of energy-efficient building envelopes. Most of this work has focussed on buildings in temperate climates which have both winter heating as well as summer cooling requirements and building envelopes are designed to be closed. In tropical hot arid and upland regions summer days will require some cooling but cool night temperatures can require significant heating so closed envelopes are often designed. In humid tropical regions there is no significant heating requirement and sealing the external envelope is not as critical particularly in building where owners prefer open envelope design to gain the benefits of fresh air and cooling breezes and ceiling fans during the evening. However, if air conditioning is contemplated in sleeping areas better sealing and insulation of the building envelope will be required to gain energy efficiency.

Mass
Mass in roof, walls and floor can provide effective thermal capacitance to slow heat transfer through a building envelope and create significant time lags in heat flow. These effects and their influence and applicability to various regions in tropical regions of Queensland have been described by Uno (1993). There are some advantages in using water ponds on roofs as the heat storage media but there is also the added problem of potential leaks. Roof ponds are discussed in detail by Givoni (1994).

Insulation

The use of massive construction tends to add material and labour costs to construction. Alternative techniques of thermal control include use of bulk insulation and reflective air spaces. Use of bulk insulation in the form of various fibre materials or expanded plastic insulation have the same thermal insulation value regardless of the direction of heat flow. In contrast the thermal insulation value of reflective air spaces is up to 3 times greater when heat flow is downward than when heat flow is upward. This means that bulk insulation will slow the dissipation of heat which accumulates inside a building during the day more than reflective air spaces in roofs.

Roof Insulation Required to Limit Ceiling Temperature to 38℃

COMMENT

The last section heading above details a mathematical stepped formula explaining the reduction of the radiative heat component 'heat flow down' through roofs-ceilings down to level below 38degC, the accepted scientific benchmark point to avoid heat gain to occupants. When combined with fresh and cooling breezes, as is common in the tropics, the thermal goal can be achieved by using 'reflective' materials, as opposed to 'resistive' bulk insulation materials.

This technical paper was widely circularised in 1999 and later, and included the ABCB. In 2003 the ABCB completely ignored this advice by setting the BCA thermal base house model nationwide (for NatHERS operation) for 'conditioned houses' i.e. artificially heated and refrigeratively cooled; the first major mistake from the ABCB, who did not offer a *free running* naturally ventilated house option.

Read the 2014 NEEBP ratings survey analysis (Timeline) which revealed for the tropics, in ceilings, foil only and no bulk insulation whatsoever.

2000 (January) – CSIRO "Collaborative Field & Laboratory Study of Summer Thermal Conditions in Roofs"

R.Clarke & A.Delsante (CSIRO), and Prof R.Aynsley

A radiation research proposal was co-ordinated by Tim Renouf, Secretary of AFIA, after being specifically invited by the AGO to submit an application for a funding grant for national greenhouse gas abatement (20 applicants were to be approved). The submission project proposal would have analysed the impact of radiation through roofs upon bulk and foil insulations.

The submission was rejected by the AGO for not producing fast enough greenhouse gas abatement.
Had the project proceeded, the evolution the HERS House energy ratings and related insulation standards may well have been very different to what transpired. Disappointment was an understatement.

2000 (February) - Insulation Industry discussion body IMAA disintegrates

Finally, and perhaps inevitably IMAA fell apart after one major incident.

The independent foil association AFIA was represented by Tim Renouf at a building forum expo on 8 March 2000, where Tim directly asked an unplanned spontaneous question to a senior person from the federal Australian Greenhouse Office (AGO) and witnessed by the IMAA Chairman: *"when was the government going to insist on high temperature radiation assessment of insulation materials?"*

The question was asked because the earlier CSIRO research proposal, a proposal still relevant to the development and completion of the primary insulation standard DRAFT AS/NZS 4859.1, had just been rejected

in January by the AGO, which obviously fuelled Tim's question to the AGO because he was thoroughly confused and wanted an explanation.

The AGO's immediate and polite response was that the radiation issue had to be resolved by Industry.
What followed next was extremely unpleasant.

IMAA were incendiary with rage against AFIA's actions. The fibreglass industry's foil manufacturing members all resigned from AFIA because Tim Renouf had not sought their permission beforehand (which they all would have refused had he asked them). IMMA swiftly convened a meeting to discuss the expulsion of AFIA from IMAA in a literal 'Star Chamber' court martial-style event with Tim Renouf the prime defendant, because the historic thread through time is that no bulk insulation grouping would ever agree to high temperature testing.

On 13 April 2000, IMAA terminated the membership of AFIA on the grounds that its executive was acting counter to IMAA's stated objectives and that recent actions by the AFIA executive in a number of important industry matters, were not representative of the AFIA membership's views. All absolutely true, because Tim Renouf put the Public Interest ahead of IMAA's self interest.

During one of the board meetings of IMAA it was casually let slip that "the main reason we are here is to sell more insulation". These words became the turning point for Tim Renouf, namely that he could clearly see that the insulation industry was determined to influence government policy slanted in favour of selling higher levels of insulation, in an unchecked and unvalidated manner, and he was prepared to take steps to stop it. Insulation products had to be 'fit for purpose' and proven to work in all climates.

The reader can be left guessing why there was negativity from IMAA approving the 2000 CSIRO proposal; some of the summer R-value claims would likely to have been found to be misleading, such as under 80-100degC flat roofs and around cooling ductwork (see evidence in this Timeline). All that AFIA was asking for then was level playing field high temperature testing for all insulation materials.

The ironic aspect to the AFIA termination was that two weeks later IMAA reversed its position and invited AFIA to rejoin IMAA, because the government would only agree to talk to 'all of Industry' in order for government participation in funding greenhouse gas abatement measures. AFIA refused the invitation to rejoin, and as a result, a cascade of the other IMAA members resigned one by one. One key player said some years later, that as things turned out Tim Renouf actually did the right thing.

After the collapse of IMAA, a variant industry body was formed in 2005 called IIMMAA (Independent Insulation Manufacturers & Merchants Association of Australia Inc.), to challenge the dominance of the fibreglass industry but it did not last long.

Accordingly and ultimately, all insulation decision making fell to Standards Committee BD-58. Its power lies in the fact that all Standards Committees operate on 'Committee-In-Confidence' policies, and still do even in light of externally recommended changes in April 2018, to open up Committees to public exposure. In other words, after IMAA's demise the 'closed shop' continued, and the public remained incapable of seriously challenging standards in any practical way.

2001 (Feb) – PATHE-HIA "Insulation Management Guide for Residential Buildings"

PATHE – Partnership Advancing the Housing Environment: HIA - Housing Industry Association, Environment Australia, Greening Australia
Contributory funding: AGO - Australian Greenhouse Office
Prepared by: HIA
Technical Assistance: IMAA - Insulation Manufacturers Association of Australia (Timeline 1996-2006), SEAV – Sustainable Energy Victoria, AS 2627.1 -1993 (see Timeline), BRANZ.

Extracts:
Introduction page

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.

PAGE 8

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

- *the inherent R value of the materials the building element is made of*
- *the R value of the added insulation*
- *the impact of combining these materials*

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, e.g. 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 e.g. 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 R2.2

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.

COMMENT

This Guidebook sought wide technical advice, including from IMAA of which the first foil association AFIA was a member. It drew also on the Standard AS 2627.1-1993, the guide for recommended levels of insulation – a commercially loaded Standard framed to sell bulk insulation batts (see Timeline 1993).

With the impending introduction of residential building energy performance regulations coming into the BCA in 2003, and adding in the POINT 3 statement above of '40% R value reduction', it seems incredible that the ABCB didn't instruct Standards to address the impact of hot roofing on insulation materials when finalising AS/NZS 4859.1 (2002) – an issue that appears in numerous reports throughout this TIMELINE. The reader could easily ask, is it because vested commercial interests controlled the writing of the insulation standard? Yes, it is. It is not uncommon for Standards' Committees to be 'captured' by vested interests, identified in the April 2018 review of Standards Australia.

To make matters worse, the 40% statement was further ignored during the revision period 2015 – 2018 of the standard AS/NZS 4859.1 & 4859.2 (2018).

2001 (June) – "The History of Heat Insulators at the National Institute of Standards and Technology

Robert R.Zarr – Gaitherburg, USA
https://ws680.nist.gov/publication/get_pdf.cfm?pub_id=860832
Significant and concise explanation of the history of heat flow test methods of insulating and building materials.

1997 – 2007 House Energy Rating Schemes under severe scrutiny in Australia

*Reports for 1997(Stein, USA), followed by 2000 & 2007 (Williamson, Univ Adelaide), grouped here for clarity of referencing.

1997 – "Accuracy of Home Energy Ratings" (Jeff John Stein – USA)

https://buildings.lbl.gov/publications/accuracy-home-energy-rating-systems

ABSTRACT Actual residential energy bills were compared to estimated energy use and energy costs for four Home Energy Rating Systems (HERS) including the CHEERS Version I rating system. CHEERS tended to overestimate the actual energy cost by approximately 50%, with large variation in the accuracy of individual ratings. In addition to normal variations in occupant behaviour, possible sources of error include inadequate rater training and incorrect assumptions about average occupant preferences for thermostat setpoints. However, for houses built between 1990 and 1994 CHEERS' average error was relatively small. The other three HERS all exhibited relatively small average errors in the estimated energy cost or energy use. Contrary to expectations, none of the HERS showed any clear relationship between the rating score and actual energy cost. Furthermore, all of the case studies tended to support the hypothesis that occupants of more energy efficient houses "takeback" some of their energy savings by using more energy services. This makes it difficult to use standard occupant behaviour assumptions for all house types and still expect average error to be small for all types of houses. The case studies also demonstrated that it is more difficult to accurately predict energy use in mild climates than in more severe climates. While accuracy does not appear to be a major concern of the HERS industry or lenders who participate in HERS programs, it is still important, especially for consumers who make investments based on HERS ratings. Improvements in accuracy can be made with additional research and possibly through some fundamental modifications in the rating systems.

COMMENT

Stein is believed to be the first person in the world to warn about House Energy Ratings.

"If you construct a model on biased and false assumptions then feed in the 'right' data and you can achieve whatever result you want" – attribution unknown.

2000 (October) – "A review of Home Energy Ratings in Australia: Policies, Evolution & Effectiveness"

Author: T.J.Williamson, School of Architecture, Adelaide University

https://www.concertinafoilbatts.com/Williamson%20-%20Adelaide%20Univ%20Oct%202000%20-%20HERS%20Review%20.html

A thorough historical explanation to understand the development of HERS In Australia up to 2000.
The document does not have its own internet link.

Extracts:

This paper traces the history of the development of NatHERS and its implementation. The paper will deal critically with the shortcomings of NatHERS. Referring to limited research data, the fundamental objectives to reduce household energy consumption and reduce greenhouse gas emission are questioned.

Theory Compared with Reality

The technological view of household energy consumption (and related greenhouse emission) inherent in the NatHERS development is based on the belief that with sufficient accuracy elements of dwelling construction e.g. overall U-value, solar penetration, shading, etc. along with an assumed occupant use pattern determine the outcome in a particular climate. Here sufficient accuracy is generally meant to account for differences that result from specific occupant behaviour and local climate variations. But what evidence exists for this belief? Does the real-world data support the moves to mandate thermal performance characteristics of dwellings based on NatHERS? In fact few studies in Australia provide data that can be used to test these questions. Three such studies are examined here, with only one related directly to a HERS assessment with actual energy consumption.

The fundamental assumption inherent in NatHERS, that the calculated energy load for an assumed use pattern relates to energy efficiency has remained a matter of scientific conviction by some and unquestioned trust by others. The belief, however, has never been tested with real-world data. An answer to the simple question "Over a reasonable life-cycle will a house with a better NatHERS rating lead to lower heating/cooling energy use compared to the same house with a lower rating?" remains in the realm of speculation. The investigations presented in this paper are probably the first attempts at

such an analysis and the results based on such small samples must be treated with caution at this stage. But the tentative conclusions on the evidence of this data, far from being encouraging, indicate that NatHERS would appear to be fundamentally flawed and will not achieve its stated aims. This conclusion is, however, not peculiar to the Australian HERS. Stein (Stein, 1997) in a detailed study of major House Energy Rating Schemes in the US which do include a consideration of plant type and fuel reported that,*

> *"One of our most surprising discoveries was that none of the HERS we examined showed any clear relationship between rating score and total energy use or energy cost." (Stein, 1997 p9)*

That such schemes could be developed so far without the basic questions being investigated is a damning indictment of the lack of primary research (read research funding) in the area. The bureaucratic processes that measure success, not in terms of basic performance objectives, but rather the number of implementation activities, eg. regulations introduced, assessments issued, etc. are also to blame. That the publicity about these schemes suggests they are "best practice" is even more remarkable.

But why, as it appears, do rating schemes get it so wrong when they are based essentially on the science and physics of heat flow? The answer is probably very simple: the real-world variations in the scientific input parameters, for example, assumed R-values, ventilation rates, etc. and factors such as occupancy patterns, heating/cooling systems and their use, etc. swamp the variations that can be explained by science based on "standard" assumptions.[1] And in the case of the NatHERS, not even the science has been fully tested. The NatHERS software (or more correctly the CHENATH simulation engine) developed by CSIRO has been the subject of only limited empirical and inter-program validation (Delsante, 1995a; Delsante, 1995b). Within the limitations of the validation methods the program performed well, but many simulation details remained unevaluated. e.g. heat flow to ground, shading, etc. More fundamentally the NatHERS simulation results seem never to have been compared systematically with actual household energy consumption data.

The findings presented in this paper give this author no satisfaction. I believe a way can be found to achieve the notion of sustainability described in the Bruntland Report. However, at present we are far from that point and to introduce mandatory energy efficiency building regulations without considerable basic research to demonstrate the real-world effectiveness and value of the scheme would seem premature and potentially counterproductive at this time.

2007 – "An Evaluation of the Nationwide House Energy Rating Scheme (NatHERS)

Author: Terry Williamson, School of Architecture, University of Adelaide
Presented: 41st Annual Conference of the Architectural Science Association ANZAScA 2007 (Deakin Univ)
http://anzasca.net/wp-content/uploads/2014/08/ANZAScA2007_Terry-Williamson_Yaara-Plaves_et_al.pdf

Abstract
In January 2003 Amendment 12 to the Building Code of Australia (BCA) included energy efficiency provisions for Class 1 (detached dwellings) and Class 10 (garages, sheds and the like). In January 2007 the stringency of the BCA provisions were increased and the second generation rating tool AccuRate was introduced. There is however little evidence to support the usefulness of the regulations in meeting the objective "to reduce greenhouse gas emissions by efficiently using energy", or in simple terms, as described on the NatHERS website, "The more stars, the less likely the occupants are to need cooling or heating to stay comfortable."
This paper reports on a recent investigation to assess the effectiveness of the regulations. Energy consumption data were collected from 22 households in and around Adelaide. From this information heating and cooling energy use was estimated and compared with the House Energy Rating derived from the AccuRate software. The results are discussed and conclusions drawn on how a more effective energy-efficiency building regulation may be framed.

Conclusions (selected extracts)
…….The analysis presented above using the AccuRate software does not corroborate the statement that there is "limited correlation between NatHERS ratings and actual heating and cooling energy consumption.."; in fact it is clear there is no significant correlation. It is not a problem with the AccuRate simulation engine per se, but rather an inherent misconception in the scheme itself. In relation to the present scheme no comfort can be taken from an improved correlation "once energy performance of appliances is adjusted for" because such a measure means that the rank order of the houses would be significantly different. In addition if greenhouse gas emission is the true objective of the BCA regulations (and the NatHERS Rating Scheme) then this should be dealt with explicitly and houses ranked accordingly.
Based on the evidence presented in this paper an even stronger statement suggesting that the existing policy will almost never result in a reduction in greenhouse gas emissions (or energy consumption or energy costs) seems justified….
____end of energy rating section____

2002 (June) – "Insulation Material Thermal Testing: Principal differences between aluminium foil and bulk insulations" - Richard Aynsley PhD

"Federal regulatory thermal performance measures for buildings should be based on products that have proven in-situ performance. Under Australia's summer sunshine, the temperature of building envelopes rise as they absorb solar radiation, particularly metal roofing which can reach temperatures from 60°C to over 90°C during calm conditions, depending on their surface colour. Heat transfer from hot external surfaces, across airspaces to the interior of buildings, is principally by infrared radiation. As the principal source of heat gain into buildings, in warm climates, radiant heat gain creates the need for indoor cooling, by airflow from breezes or fans, evaporative coolers or refrigerative airconditioning. The latter, consumes significant amounts of electrical energy. Greenhouse gas emission reduction is focussed on reducing the burning of fossil fuel to generate electricity.

As proven, in the past, by international studies, and known by all authorities, the low emissivity of aluminium foil materials (typically 0.03) facing an airspace, reduces radiant heat transfer by around 97%. In warm climates, these radiant barriers significantly reduce the costs of cooling building interiors. Established testing of resistive bulk insulation materials using a Heat Flow Meter, involves moderate temperatures up to 33°C, but does not address radiant heat transfer.

Authorities should be pro-actively constructing energy codes that require testing of all insulation materials to be used in Australian buildings take account of radiant heat transfer. "

Richard Aynsley, B.Arch(Hons I), MS(Arch Eng), PhD.
Member : AIRAH & ASHRAE
Former UNESCO Professor of Tropical Architecture, James Cook University, QLD
Dean, Faculty of Engineering Technology and Management, Southern Polytechnic State University, Marietta GA, USA

2002 (December) – Creation of AS/NZS 4859.1(2002) - the first unified insulation standard in Australia

This standard evolved over a four year period and extinguished all pre-existing separate insulation product standards, and created a unitary document covering all bulk insulations and reflective insulations, in order that it could be referenced in the BCA Building Code of Australia, Residential Building Energy Efficiency Provisions 2003.

Bulk insulations are thermally tested (R-values) to an international Steady State method at a fixed 'mean' temperature of 23degC for 4 hours, which measures conducted heat flowing between two temperature plates set 33 & 13degC with the insulation material sandwiched in between. The machine is not measuring high radiant heat loads of typically 50-70degC commonly found in roof spaces in hot climates across Australia, a feature greatly less so in Europe and North America.

Reflective foil insulation product R-values are undertaken by mathematical computation, historically derived from the work of USA HR-32 1954 Robinson & Powlitch.

It did not take long for the standard to be deficient in lacking guidelines for calculation of reflective insulations, for matters such as dust and airspeed effects. Industry tensions also steadily intensified as Amendment 1 (2006) took shape, coupled with HERS house energy ratings on a trajectory rising higher, which meant thicker fibre batts being sold – a simple commercial imperative that was not to be impeded, by anybody at any time.

2003 - Building Code of Australia – Residential Building Energy Efficiency Provisions introduced

This was the date that national mandatory thermal regulations for new residential buildings were introduced into the BCA, and were progressively adopted state by state. The methodology was based on heating for majority of the house, and whole house refrigerative air conditioning, a carry over base assumption used in AS 2627 (1993).

Two compliance options:

a) Prescriptive Minimum Total R-vales for roof-ceilings, walls and floors OR
b) House energy ratings. Originally set at 3 Star, then 5 Star(2006), then 6 Star(2010) – NatHERS administered.

The regulations were fatally flawed from the beginning because they never allowed for a house option being naturally ventilated, also known as 'free-running'. NB: Observe the relevance of AHRC Queensland 1981 report (in ceilings, using reflective foil and no bulk insulation), and the fact that it was ignored by the ABCB.

2005 (February) – "Insulation of Roofs in Warm Climates"

2005 CIB W92/W107 International Symposium on Procurement Systems, Las Vegas, NV USA
Author: Richard Aynsley (Delta Corp, Lexington, USA) and Bin Su (School Architecture UNITEC Auckland, NZ)

ABSTRACT

There is currently no guideline for builders or home owners to indicate what would be appropriate thermal insulation in roofs to control summer heat gain through roofs in naturally ventilated houses in regions with little or no winter heating requirement. Australian Standard AS 2627.1-1993 indicates recommended values of thermal insulation for roofs and walls at numerous locations around Australia. These recommended values are based on an economic analysis balancing the lifetime cost of installing the insulation during construction against the heating and cooling energy cost over that lifetime. These levels of thermal insulation assume that the house has a closed envelope and is heated or cooled to maintain indoor thermal comfort. In warm, humid climatic regions, houses are often designed with open envelopes to benefit from natural ventilation. Two objectives are proposed for thermal insulation in roofs of houses with efficient cross-ventilation in regions with little or no winter heating requirement. The first is to limit the daytime surface temperatures of the ceiling to prevent infrared radiant heat gains to occupants. The second objective is to design roof insulation that promotes rapid cooling of the house after sundown. A field study to investigate the thermal conditions in houses in a warm humid climate region, and the resulting indoor thermal conditions, was based on a survey of 92 houses in Townsville, Queensland, Australia. A procedure for evaluating roof insulation alternatives is provided.

CONCLUSIONS

Evening hours are the most critical for indoor thermal comfort in naturally conditioned houses in Townsville as the occupancy tends to increase and the sea breezes tend to die away by 9:00PM when many people are trying to go to sleep. Ceiling fans can provide useful air flow during this critical period.

Two objectives have been proposed for thermal insulation in roofs of houses with efficient cross-ventilation in regions with little or no winter heating requirement. The first is to limit the daytime surface temperatures of the ceiling to less than 4K above indoor air temperature to prevent infrared radiant heat gains to occupants. The second objective is to design reflective roof insulation with a low thermal resistance to upward heat flow to promote rapid cooling of the house after sundown.

It can be seen from the above calculations that the reflective foil insulation works like a one way thermal valve. Thermal resistance to downward daytime heat flow to limit ceiling temperature is 3.21 m^2.K/W. The same reflective insulation has a much reduced thermal resistance of 0.67 m^2.K/W to upward heat flow due to radiant cooling to the night sky. In comparison, bulk insulation such as fiberglass that has a thermal resistance to downward daytime heat flow of 3.58 m^2.K/W, has a thermal resistance to upward heat flow due to radiant cooling to the night sky of 3.03 m^2.K/W.

2005 (Feb) – Meeting convened by Standards Australia in Sydney for whole of insulation industry - Chaired jointly by AGO and ACCC (actions extended through to 2009)

Convened to discuss the need for Standards Conditions and Guidelines for Reflective Insulations.
This meeting was historic for it was the very first time that the entire insulation industry had met in one room, and many attendees were astounded that it had ever happened.

Basically, the ACCC read the riot act to the industry that a range of insulation conformance issues had to be addressed, and this included thermal performance claims made for heating and cooling flexible ductwork in roof spaces.

Ductwork issues were formally addressed separately at a meeting in 2006 between the AGO, ACCC and the ductwork industry, and evolved through stages to 2009, and which culminated in a research report identifying the serious impact of radiation in the roof space upon flexible cooling ductwork in residential roof spaces. See Timeline - Feb 2016.

Certain episodes at this historic meeting were memorable but cannot be put into print.

2005 (March) – "Insulation Solutions to Enhance the Thermal Resistance of Suspended Timber Floor Systems in Australia"

Author: Dr T.Williamson & B. Beauchamp, Univ Adelaide
For: FWPA – Forest and Wood Products Research & Development Corporation
https://www.fwpa.com.au/images/marketaccess/PR05.1014_0.pdf

This under floor study was commissioned by FWPRDC (Forests Wood Products), undertaken by Univ Adelaide for assessing underfloor insulation options on the market (to meet the 5 Star levels).
A wide range of insulation types were examined, including fibre batts, styrene board and Foil Batts.

"Summary and Recommendations" (pgs 1-3)
The report, repeatedly recommended more research.

Extracts:
"It is recommended that the timber industry undertake research to determine the range of sub-floor ventilation rates that apply to Australian construction practices. Also, it is recommended that the timber industry work to ensure a more realistic representation of suspended timber floors in rating scheme software such as NatHERS, First Rate, and AccuRate to better account for sub-floor ventilation rates."

"With regard to the likelihood of moisture entrapment to condensation within an insulated timber floor system, this study found it to be a complex matter and a source of confusion to both practitioners and consumers alike, and recommends that a comprehensive research programme be conducted to measure the degree of various environmental parameters and regional differences to establish improved design methods and installation techniques and the impact on rating tools".

COMMENT
Through this entire Timeline, **a sustained pattern keeps on repeating**, that government refuses to enact a national insulation testing research program.

2005 (August) - Productivity Commission
"The Private Cost of Effectiveness of Improving Energy Efficiency"
https://www.pc.gov.au/inquiries/completed/energy-efficiency/report

Final report - extracts:

10.4 Are building standards cost effective for individuals?
How effective are the standards in reducing energy consumption? (pg. 219)

The effectiveness of current building energy efficiency standards in reducing energy consumption has not been tested comprehensively (Footnote 3). Instead, policy makers have assumed that the energy savings predicted in regulation impact assessments and supporting research have been realised in practice. This is unlikely because the predictions are based on many questionable assumptions, and they ignore numerous practical problems in implementing the standards.

Assumptions used to predict energy savings
Predicting the energy savings that result from a building standard is difficult because it depends on numerous factors, many of which are not well understood.
An important example is the behaviour of a building's occupants. This is likely to be a major determinant of how much energy is saved with a building standard, but there is remarkably little data available about the behaviour of building occupants. Nevertheless, it is obvious that occupant behaviour varies markedly across the population and this will lead to considerable diversity in the energy saved by individuals.
Another important determinant of energy savings will be the type of heating and cooling appliances an occupant uses, and how efficient those appliances are. Again, this is likely to vary considerably across the population, but limited data are available on this issue.

Footnote 3: Energy Efficient Strategies (2000) examined the impact of Victoria's mandatory insulation requirements (introduced in 1991), but it simulated (rather than measured) energy savings for individual dwellings (using FirstRate software) and relied on many questionable assumptions due to the limited availability of data on issues such as appliance efficiency and user behaviour.

(pg. 226)
Dr Williamson submitted case study results for six houses that had won awards from the Royal Australian Institute of Architects. The houses had below-average energy consumption, but achieved only a 0 or 1 star rating using approved simulation software:
"Each house was rated using NatHERS and/or FirstRate software and results compared with actual consumption and AGO projected average house consumption for the areas ... The houses in each case were built prior to the introduction of mandatory energy efficiency regulations. Despite each of these houses having energy consumption results well below the 'average' house in the location, based on the star rating results, none could now be built because they do not achieve the required rating criteria."
(sub. 28, p. 25)
In the draft report for this inquiry, the Commission noted that Dr Williamson's case studies raised doubts about the effectiveness of building standards in reducing individuals' energy consumption.

Submission DR133: Dr Terry Williamson, School of Architecture, Adelaide University
https://www.pc.gov.au/inquiries/completed/energy-efficiency/submissions
(scroll down list to find DR133)
This submission revealed what is so badly wrong with the government decisions to rely on House Energy Ratings. Some quotations to think about:

pg 1, 4th para
"there is little or no evidence to show that energy efficiency standards and regulations (including HERS) will be in any way effective".

Pg 8 - The possible future Occupant
"The issue of designing and building now for the future is raised in several submissions.....Since we cannot be sure of the needs and preferences of future occupants our best attempts now at energy efficient designs may be overturned in the

future. Needs and preferences in a market driven world can be manufactured by advertising campaigns. For example, buildings originally designed in the 1970s to operate on passive solar principles without air-conditioning may now have air-conditioning installed and can be said therefore to be less efficient….
A meaningful method of Mandatory Disclosure of Energy Performance of Residential Buildings would do a lot to ensure prospective future owners/tenants are made aware of the likely implications of occupancy."

Pg 9 The Question of Comfort
"An adaptive school of thought sees domestic sustainability as dependent on the creation of carefully constructed opportunities for people to exercise control over their thermal environment and for choosing natural as opposed to artificial means of heating and cooling.
To examine temperature readings or computer output and pronounce a building comfortable or not comfortable related to standardised thermal comfort conditions, acts to institutionalise both comfort and lifestyles. Taking a big picture view concerning visions of sustainability around which policies promoting energy-efficiency revolve, this is exactly the wrong way to progress".

COMMENT

The Productivity Commission report found that HERS ratings were unreliable, and drew heavily upon the evidence given by Dr Terry Williamson (Univ Adelaide). The supporting evidence for HERS ratings, included ICANZ and its consultants.

It is important to recall that Dr Williamson's comments about the opportunities for natural rather than artificial means of heating and cooling, have direct relevance stemming from the 1981 AHRC Qld testing report (See Timeline) which Dr Williamson was a key team member. That report concluded that for naturally ventilated houses, foil insulation across ceilings in Queensland was preferable than using bulk insulation.

This entire Timeline is intended to demonstrate an overall picture, which is that rising Star ratings and bulk insulation levels do not equate with physical proof of reductions in running costs for heating or cooling.

2005 (October) – "Comparison of Thermal Conductivity Measurements of Building Insulation Materials under Various Operating Temperatures"
Publisher: Journal of Building Physics, Volume 29, No.2
Author: Adel A. Abdou & Ismail M. Budaiwi – Dept of Architectural Engineering, King Fahd Univ, Saudi Arabia
https://journals.sagepub.com/doi/abs/10.1177/1744259105056291?journalCode=jend
Notes:
i) thermal conductivity (k-value)
ii) the report refers to 24degC 'mean' temperature base testing at Steady State, where 23degC 'mean' (4 hour laboratory duration) is used for labelling purposes for all bulk insulations across Australia

CONCLUSIONS
The impact of operating temperature on thermal conductivity has been investigated. Thermal conductivities for various insulation materials were measured at different operating mean temperatures using an automated heat flow meter……
Although the relevant standards require measuring and reporting the nominal k-value of insulation material at 24degC (i.e., k24) inconsistency in measuring and/or reporting the k-value of insulation materials by manufacturer was observed and documented. The results of this study call for the need to set mandatory regulations for thermal insulation material manufacturers to not only abide by the standards requirement but also to provide the k-values of their insulations at higher temperature e.g. 34-35degC or higher to account for their applications in harsh climatic conditions and allow building designers to evaluate the thermal performance of building envelopes considering the actual operating temperature leading to a more realistic assessment of energy requirements. The results can be used as a base for further investigating the influence of humidity and moisture on the overall thermal performance of insulation materials.

COMMENT

These outcomes are precisely what the writer has been consistently calling for, in Australia, since 1996 – to account for the actual operating temperature expected to be encountered across Australia, noting that 23degC is inadequate for many climatic situations.

As stated in other parts of this Timeline document, a long pattern of misleading evidence exists with labelling of many fibrous bulk insulations, claiming "guaranteed performance for 70 years". An example of what is on labels of some bulk fibrous insulation is provided here.

PRODUCT PERFORMANCE

- *The total R-value depends on installation and may be greater or less than the R-value of the product*
- *The material R-value represented on this pack was determined at a mean temp. of 23degC as per AS/NZS 4859.1.*
- *The material R-value is independent of heat flow direction (the same R-value is achieved in summer and winter conditions).*

The above statements are correct, as per steady state laboratory measurement (two plates set at 33 & 13 degC, average/mean = 23degC) for 4 hour test duration. Changing orientation does not affect the resistance (R-value) to heat flow - up, down or sideways.

However, a lay person reading this label could readily believe that the bulk insulation product has a fixed 'guaranteed' R-value in any application in any climate; it is only guaranteed to a 4 hour laboratory test. Evidence justifying this is found in the Saudi Arabia report, the 2013 NCCRF Univ of SA report, the ACCC challenge against fibreglass provided free to Birdsville QLD, and numerous other Timeline entries.

Later in the Timeline 2018, saw the publication of a major revision of the key insulation standard, whereby mathematical formula adjustment for variable conductivity (k) levels for bulk insulations have been presented. Unfortunately, the new standard is utterly incomprehensible, no explanatory notes, no guidance, and worst of all, the variations appear to be entirely voluntary in application. Which means, nobody will do it.

2006 - AS/NZS 4859.1 (2002) Amendment 1 (2006) published
Incorporating Standard Guidelines & Assumptions for Reflective Insulations

This amendment became imperative to make the original insulation standard 2002 capable to function for reflective insulations, via 'Standard Guidelines & Assumptions' (e.g. airflow, dust), and other related issues imposed by the ACCC and AGO on to the standard (see 2005 AGO-ACCC meeting). The foil association AFIA led these changes represented by Tim Renouf and the then AFIA President Brian Tikey who attended the cross-industry discussions.

This revision process spanned two years and has had very complex dimensions. The following is intended to be a snapshot of the detail, and is best explained in a commentary largely written by Prof Richard Aynsley, primary technical consultant to AFIA from 1998-2013.

REFLECT-3 and ASTM C 1340-1999

Earlier in 2003, Prof Richard Aynsley instigated and devised REFLECT-3…..

"a user friendly, state-of-the-art, PC software tool for computing R-values (both up and down) for the calculation of R-values, up and down, in plane air cavities, reflective, non-reflective and multiple, at 0, 45 and 90 degrees inclined orientations, for a range of temperature differences and materials, based on Robinson & Powlitch (HR-32 1954 USA) heat transfer methods, with conduction/convection corrections and curve fitting by David Yarborough, utilizing his important

reference document "Assessment of Reflective Insulation for Residential and Commercial Applications", ORNL (Oak Ridge National Laboratories), Tennessee USA 1983. The term plane refers to cavities with parallel surfaces.

The REFLECT-3 computer program evolved from the revised REFLECT-2 program. REFLECT-3 was then rewritten by Richard Aynsley and Glen Allen from Southern Polytechnic State University with ORNL's permission in Visual Basis as REFLECT-3. REFLECT-2 formed the basis for later work on the ASTM C 1340-1999 standard.

ASTM C 1340, is a pivotal USA standard, and with software, is for calculation of heat transfer through ceilings under reflective roof spaces (attics). The software REFLECT-3 is important because it is the only program handling heat transfer through complicated roof space geometries, with a wide range of ventilation rates through the attic space. "It is the only standard with software capable of predicting heat flow through attics that have been validated against physical measurements both in the ORNL Large Scale Simulator and in field studies."

Insulation Industry tensions get to breaking point

The battle for who held control of determining the 'Standard Guidelines' for reflective insulations hit its zenith at one meeting (around 2005) held in neutral territory of CSIRO Division of Building Research, Highett, Melbourne, between the independent foil association AFIA and its foil counterpart, the fibreglass industry FARIMA-ICANZ companies manufacturing both bulk insulations and foil laminates. The extremely tense meeting had to be chaired by the Australian Aluminium Council (AAC), acting as a neutral mediator. Recall that the AAC had ceded its vote on Standards Committee BD-58 to AFIA in 2000.

At this point, the reader is probably thinking where is this complex story going? Why couldn't all the foil laminators work together to thrash out the necessary commonly agreed 'Standard Guidelines & Assumptions' for reflective insulations?

The simple answer was that AFIA wanted to pursue not just Standard Guidelines for foil insulations but to include high temperature level playing field assessment for all insulations, because bulk insulation didn't have any guidelines – they were able to be sold at a fixed temperature measurement of average 'mean' 23degC (i.e. two plates set at 33 & 13degC = 46deg divide by two = 23degC). And it didn't seem fair (and still doesn't) to sell bulk insulations across Australia in any hot climate, under such fixed static laboratory conditions, while foil insulations had to have better defined boundary conditions. Recall AFIA's lodgement to the AGO of the CSIRO radiation testing proposal in 2000 which had foundered and went nowhere.

The meeting which had Tim Renouf and Brian Tikey attending representing AFIA, had had a pre-condition before commencement that there would be no discussion about Climate Simulation thermal testing as is undertaken at ORNL in the USA, i.e. the replication of climate in a very controlled manner. The meeting rapidly got to incendiary levels because, before the meeting started, it was known that the ICANZ opposition grouping of foil laminators had been tearing down the credibility of the computer program REFLECT-3, in a desperate attempt to take control of the determination of calculating foil insulation R-values, because they manufactured the majority of foil laminates in Australia.

One of the most tiring statements repeated by ICANZ in report after report, is that ICANZ members manufacture 70% of all foil laminates across Australia and so therefore by extension they were in the best position to represent foil insulations. This flies in the face of ICANZ's confirmation in a number of Inquiries that ICANZ openly represents bulk insulation ahead of foil insulation.

Confused?

The central point is that the commercial interests of fibreglass insulation production have always overridden that of foil laminates, the fact being that fibreglass manufacturing process is a 24/7 operation, i.e. the machines have to keep running. Accordingly, RFL foil promotion must always come second to that of making and selling fibreglass insulations, and if foil at any time has to be thrown under the bus, then so be it (e.g. the engineered ever rising BCA-NCC 'Total R-values', and the 2019 NCC condensation changes).

However, in the situation described above, AFIA won the battle and the creation of REFLECT-3 was secured.

Consumers Federation of Australia

To fill in the picture even more, the Consumers Federation of Australia (CFA) has had a place on Committee BD-58 for decades and falls within the orbit of the ACCC. The CFA remains totally silent about its actions regarding building energy efficiency and appears to refuse to respond to any questions on the grounds of 'Committee-In-Confidence' rules.

The reader might have thought that the CFA would intervene in the development of insulation standards and support real time thermal testing, particularly in light of the predictions of 50degC temperatures increasingly hitting greater parts of Australia.

It is the opinion of the writer that the insulation industry would be close to the top of the list of any industry for lack of unity, purpose and consideration for the public interest.

2006 (March) – "Regulation Impact Statement: Proposal to amend the Building Code of Australia to increase the energy efficiency of requirements for houses" – 2006a
(the case to raise star rating level to "5 Star")

After extensive searching of the internet, all reference to this RIS has been deleted, as well as the "Draft Regulation Impact Statement (RIS 2005-02) - April 2005", of which the writer fortunately has a hard copy.

COMMENTS

1. The Draft RIS is massive and close to incomprehensible.

2. The front face page of the Draft RIS has the commentary: *"The Draft Regulation Impact Statement (RIS) has been prepared in accordance with the principles and Guidelines for Standard Setting and Regulatory Action by Ministerial Councils and…….Its purpose is to inform interested parties regarding a proposal to make new regulations. Comments are invited and should be addressed to the contacts at Appendix H by 12 May 2005".* *This deadline was impossibly tight to lodge a Public Comment

3. Pg 46, A1.5 Estimates of benefits and costs.
"Estimates of unit cost of improvements were drawn from suppliers and installers; consultations with two key industry organisations - Fibreglass and Rockwool Insulation Manufacturers Association (FARIMA) and the Australian Glass and Glazing Association (AGGA)……."

4. An analysis of '5 Star effectiveness' was conducted in a substantial report by CSIRO in 2013 (see Timeline), seven years after its introduction. In brief, its findings were that energy use was reduced to maintain heating in winter, while average cooling energy in summer was greater with 5 Star levels. Was it possible that increasing the levels of bulk insulation in housing contributed to the negative impact for more energy needed for cooling?

5. Why has all trace of investigations to introduce 5 Star building energy efficiency (and the higher insulation levels) been removed from the ABCB website? One conclusion is that the ABCB jumped the gun, didn't do the appropriate investigations regarding real house energy use for heating and cooling, and pushed ahead under political pressure to be seen 'taking action'. Then the ABCB eliminated all internet reference to the 5 Star RIS process.

6. And made worse, when the ABCB continued on and implemented 6 Star regulatory changes in 2010, when an official post-5 Star analysis had not even commenced. Which leads to the plausible conclusion that persistent lobbying by a range of commercially loaded vested interests invariably influence government decisions.

2006 (27 October) – "Thermal Performance of Flexible Air-Conditioning Ductwork"
Meeting of Industry in Melbourne - Chaired by AGO, Australian Greenhouse Office

Summary of some main issues recorded in Minutes taken by the AGO

Significant changes to the Building Code of Australia (BCA) over the previous eight years had led to improved markets for the insulation industry, particularly in the residential sector. Thermal performance of the building shell was extending into air conditioning performance and ductwork.

The next stage in a natural progression was to look at a way to ensure that consumers get what they pay for in terms of Thermal Performance. A brief overview was provided of Australian Standards that cover flexible air-conditioning ductwork.

AGO did testing in 2004, prior to changes in BCA 2005, of bulk insulation products with some test samples falling below labelled value. The AGO has been working in consultation with the ACCC and intended to keep the ACCC advised of future outcomes.

A Senior Investigations Officer with the ACCC, provided the meeting with an overview of the Trade Practices Act and the role of the ACCC in enforcing the Act. He told the meeting that insulation products were on the radar of the ACCC.

One possible testing solution for testing completed flexible ductwork was presented., allowing the duct to be tested in a complete state, rather than the current practice of testing the insulation in a flat form.

The flexible Air-Conditioning ductwork industry would ideally guide the process, through an existing or new steering committee.

The AGO suggested that the AGO approach a University, with RMIT as an example to see if an Honors engineering student may be interested in developing the test unit.

AGO suggested the establishment of a small industry steering committee to commence work on the process, and it was reported that Master Plumbers Association already had a sub-committee and AGO could get involved.

COMMENT

This sub-committee occurred and in 2009 a technical report on ductwork performance was issued by a private company. One feature of the report revealed was that radiative heat transfer upon cooling ductwork was a substantial issue.

This Timeline section information was provided to the writer in 2013 by a senior ductwork industry manufacturer. It helped greatly to fill in the jigsaw about what was happening in one aspect of the insulation industry, which many people would not have known about.

The information from this AGO meeting added gravity to the letter written by the writer to Standards in 2016 (see Timeline Feb 2016) requesting serious action be taken on the impact of radiation upon cooling ductwork, in which the public were being deceived by false thermal testing methods and therefore grounds actionable under Trades Practices. Once again, more 'real world' testing was needed.

2006 (Nov) - Productivity Commission Research Report
"Review of Australian Government relationship with Standards Australia & National Assoc of Testing NATA"

This review included examining the efficiency and effectiveness of standards setting and the government's role.

Central issues: standards must provide consumers with greater certainty about the quality and safety of products; and they are increasingly used by governments to address concerns about social issues and the environment; the risk is that standards can be used inappropriately to limit competition among local producers resulting in net costs to the community.

Key findings
*Australian government participation on SA's governance bodies and on technical committees to ensure the standards will *serve the public interest and not inhibit competition*
*justification for new standards be made more transparent, including reasons for publication, and ensuring that the primary decision criteria is a *net benefit to the community as a whole*
*Increase the participation of small business, academic, consumer and other community interests
*ensure appropriate balanced representation on technical committees
*need to state publicly the names of committee members and the companies they work for
*absence of a systematic and transparent consideration of costs and benefits
*more rigorous impact assessment when standards are referenced in regulations
*accessibility and cost of Australian Standards
*difficulties accessing suitable expertise on a volunteer basis to participate on standards writing committees
*poor project management
*need for a more formal appeals and complaints mechanism

COMMENT
Many of these concerns were raised 10 years earlier (Kean Report 1995), and had not been achieved.
The 2006 report caused Standards Australia to issue a public announcement that SA had no choice but to make changes to the organisation, or face the prospect of ceasing to exist. However, SA did not fulfil many of the 2006 report findings.

2007 (January) – Withdrawl of standard AS 2627.1(1993)
"Thermal Insulation of dwellings – Part 1: Thermal insulation of roof/ceiling and walls in dwellings"

This document provided recommended levels of insulation for heating and cooling, for listed locations across Australia. It evolved from an earlier 1983 standard based on heating alone. Refer to earlier detailed explanation as to its severe deficiencies.

AS 2627.1 was withdrawn by Standards Committee BD-58, after the national BCA 'Residential Building Energy Efficiency Provisions' 2003 were finally adopted by every state and territory of Australia.

2007 (June) – 'Architectural Science Review' (ARS) - Letter to Editor

Author: Dr Richard Aynsley (former Prof of Tropical Architecture, James Cook Univ. QLD)

Regarding *Modelling efficient building design: A comparison of conditioned and free-running house rating approaches* by M.Kordjamshidi, S.King, R.Zehner, D. Prasad ARS 50(1), March 2007

https://www.tandfonline.com/doi/abs/10.3763/asre.2007.5013

The complete Letter:

https://www.concertinafoilbatts.com/Aynsley%20-%20Architectural%20Science%20Review%20-Letter%20to%20the%20Editor%20-%202007.pdf

Letter extracts - not the continuous full text

This is an extremely important paper as it could be used to argue for better treatment of energy efficient, free-running housing in Australia under house energy rating schemes. The Australian Building Code provisions for energy efficiency and its associated home energy rating scheme have resulted in a majority of new houses being air conditioned, particularly in warmer climate regions of Australia (Miller & Ambrose, 2005)…..

From Table 4 in the Kordjamshidi et al paper, observations regarding the influence of insulation in the building envelope reflect the findings of a study by the University of Melbourne (1981). For a well ventilated, free-running house with more than 30 air changes per hour, the indoor air temperature is equal to outdoor air temperature. It takes only a few seconds for air to pass through the house. The function of envelope insulation in free running houses is to limit indoor surface temperatures to less than 4K above air temperature with an upper limit of 38°C. This prevents the surfaces becoming significant sources of radiant heat gain to occupants (Koenigsberger & Lynn, 1965). This is most important with respect to ceiling insulation as people are more sensitive to radiant heat from ceilings than other room surfaces (ISO 7730, 2005). The total thermal insulation needed for roof and roof space to ensure that ceiling temperature do not exceed air temperature by more than 4K under maximum sol-air temperature conditions can be calculated using Equation 2……

In winterless climate locations such as north Queensland, it is important to utilize reflective air space insulation in roofs. *This takes advantage of the lower resistance to heat flow up of a 100 mm reflective air space during nighttime, around 0.48 m2K/W, to heat flow down during daylight hours, around 1.42 m2K/W. This characteristic speeds house cooling after sundown (Aynsley & Su., 2005). Other types of roof insulation trap heat stored in walls and floors during the day indoors, slowing radiant cooling from the roof at night. Metal roof temperatures at night in Townsville, north Queensland, cooled by radiation to the sky have been measured at up to 8K below air temperature….*

With respect to a rating scheme for free running houses, ISO 13791 (2004), Thermal performance of buildings: Calculation of internal temperatures of a room in summer without mechanical cooling – General criteria and validation procedures, could provide a suitable framework for assessing summer performance. Data tables in this standard would need to be replaced to reflect Australian conditions. Radiant heat transfer sections would need to be expanded to accommodate reflective air spaces that are not widely used in Europe.

Before embracing ISO standards, it is wise to review tabulated design data. The ISO 13791 (2004) standard, for example, provides design data for 40° and 52° latitude. Where does 40° latitude fall with respect to Australia? Try the middle of Bass Strait! In other words, European free-running data is irrelevant to mainland Australia. Clearly Australia and other countries need standards like ISO 13791, but substantial work is needed to assemble the climatic design data needed.

Comments from the Authors

The authors are very pleased to note Dr Aynsley's comments. The definition of 'free-running' performance used in the paper explicitly excludes the use of fans. While supported in the literature to avoid the complex issues of 'predicted energy use' (as distinct from the 'heating and cooling space loads' calculated by the software tool), we acknowledge that this definition becomes overly restrictive when more generally applied. Thus, Aynsley is correct to highlight that where fans are used for fine control of ventilation in warm climates, the building could still be safely characterised as 'free running' in contrast to 'artificially cooled'. If we need any excuse for excluding fans from our analysis, it is only that the reported study was explicitly confined to temperate climate zones.

We also agree that if a sensitivity analysis similar to that reported in the paper were to be employed to extend the proposed rating framework to warmer climates, it would be necessary to consider a treatment of radiant temperature

beyond that incorporated in the simulation tool itself. The relatively simple method proposed by Aynsley is very appropriate, and highlights the critical importance of the correct level of ceiling insulation in free-running dwellings under overheated conditions

COMMENT

The ABCB never accounted for free running houses in the development of the Building Code, and the problem persists to the present day, after endless warnings.

The Aynsley explanation provides further justification for a re-construction of the Code to provide for insulation systems in free-running naturally ventilated buildings in dominant hot climates with demonstrated technologies enabling high R value 'down' and low R value 'up'. Such buildings would logically use ceiling fans. Aynsley cross references the Univ Melbourne 1981 study which studied housing units across QLD, requiring reflective foil in ceilings and not bulk insulation, for naturally ventilated houses, as well as foil as a minimum in conditioned houses (See Timeline 1981 AHRC QLD report).

2009 (Feb) – Implementation of 'Home Insulation Program' (HIP) - response to GFC (Global Financial Crisis)

Purpose: to provide a rapid economic stimulus to the insulation industry, while simultaneously providing residential energy efficiency improvements.
Delivery: Free insulation for roof-ceilings of houses, based on AS/NZS 4859.1 (2002), up to a $1600 limit, fitting R3.5 batts, with an alternative option of selecting reflective foil insulation alone in roof spaces for 'heat flow down' dominant hot climate/winterless locations.
Two stage roll out: February (public paid upfront, then reimbursed), July (government paid upfront).

At no stage did federal and state public servants question whether the 2002 insulation standard was a reliable reference tool, and whether bulk insulations were suitable in predominantly hot-humid climates where roof spaces typically experience high radiant heat loads. The earlier Timeline reports of AHRC-Qld 1981 report & AGO 2001 Insulation Management Guide, should have been ringing alarm bells, but were ignored. Additionally, roof space electrical safety warnings were ignored prior to the high speed Stage 2 roll out phase. See Royal Commission findings 2010 (in Timeline).

2009 (May) – "Mechano-Sorptive Nailplate Backout in Nailplated Timber Trusses"
For: Forest & Wood Products Australia (FWPA)
Researcher: P.Paevere CSIRO, Highett, Victoria
https://www.fwpa.com.au/images/marketaccess/PNB036-0607_0.pdf

1.8. Key Conclusions & Recommendations
Nailplate backout can occur when cyclic mechano-sorptive swelling and shrinking of wood results in a ratcheting mechanism in which withdrawal deformations accumulate. Many of the reported examples of mechano-sorptive backout in 8 'problem roofs' have occurred in un-sarked concrete tiled roofs and/or in roof spaces with evidence of water penetration. However, there are also many examples of general separation of nailplates from parent timber that can be most likely attributed to manufacturing and handling errors, warping of timber, and overloading. Some observed cases of gaps under the nailplates have no apparent explanation. Based on data collected during a program of 'random' roof inspections, it can be concluded that moisture-related backout does not appear to be a widespread and systematic problem in trussed roofs. However numerical modelling has indicated that long-term humidity fluctuation, wind-driven rain, and roof leaking can all be a potential threat to the long-term performance of nailplated roof truss systems. Confidence levels for both of these findings are low due to limited availability of data. Laboratory experiments in which joints were

subjected to cycles of wetting and drying have showed that highly loaded joints can potentially fail to rupture under a small number of cycles of wetting and drying.

Field monitoring has shown that installation of sarking in a tiled roof will result in a drastic reduction in the amplitude of the daily humidity fluctuation compared to an unsarked roof, and also reduced potential for backout caused by moisture penetration due to cracked or loose-fitting tiles.

Based on the conclusions of this study it is recommended that :
1. Sarking or equivalent measures to prevent external moisture penetration should be adopted for all roof construction in Australia. Sarking of tiled roofs is already compulsory in Queensland, and the Building Code of Australia already specifies that a building is to be constructed to provide resistance to moisture from the outside. Universal adoption of sarking to prevent external moisture penetration would serve to minimize potential for mechano-sorptive backout, and will also result in other benefits such as more durable construction overall, and enhanced thermal efficiency. It should also be noted that there should be no water penetration into the roof space from mechanical equipment, and it may be prudent for enhanced long term performance to vent steam from kitchen and bathroom to the outside where possible rather than directly into the roof space.

COMMENT
'Sarking' in this report refers to a conventional roll form aluminium foil laminate membrane.
Once again, the ABCB and Standards Australia Committee BD-58 (responsible for insulation materials) have not acted or responded to this powerful recommendation for the multiple benefits of aluminium foil sarkings.

2009 (September 20) – Email correspondence Dr Ted Harkness to ABCB
Context: Communications prior to introduction of proposed significant increases in levels of insulation for adoption into the BCA May 2010.

COMMENT
This is the most powerful and concise warning by the public sent to the ABCB, and was ignored.

Subject: *Insulation of R2.5 is sufficient re BCA*
Date: *Sunday, 20 Sep 2009 21:12:19 +1000*
From: *Dr E L Harkness* *<tedharkness@edwardleoharkness.com>*

Dear XXXXXX,

R2.5 is adequate for insulation on ceilings in all but the most extreme Australian climates.
Building owners' money would be better spent on addressing heat gain and loss through other building envelope elements.
Most roofs would also have foil under the roof covering and in the case of metal deck roofs a blanket of R1 insulation.
There is a law of diminishing returns.
Shading systems is where money would be better spent to reduce instantaneous heat gain through glazing.
Increasing the width of eaves to shade walls and windows would be positive.
Additional insulation on ceilings is not necessary.

There must be an unscientific special interest group lobby active to propose more than R2.5 for insulation on roofs.
Who are these people? Are they bulk fibre manufacturers or in the pay of bulk fibre manufacturers?
Please ensure that they are identified and insist that they provide scientific proof of their claims.
Better still, simply put a stop to what is understood to be a move to use more than R2.5 on ceilings and encourage shading of windows; preferably shading of clear glass; and discourage the use of high performance glass which reduces daylight admission.

There are star ratings and there is BASIX which enable the designer to achieve a rated performance by employing appropriate design options.

The unnecessary additional insulation would increase the carbon footprint by the energy consumed and emissions caused by the manufacture, transportation and installation of this unnecessary additional bulk insulation.
The cost of housing would increase unnecessarily.

The way to energy efficiency will be via appropriate design for climate; not misguided regulation that will waste money and resources; and increase emissions.

Regards,

Ted

Dr E L Harkness
FRAIA FIEAust CPEng
ABSA Assessor 20494
Senior Lecturer
Discipline of Architectural Science
Faculty of Architecture
University of Sydney NSW 2006

2009 (December) - Final Regulation Impact Statement for Decision (Final RIS 2009-06)
"Proposal to Revise the Energy Efficiency Requirements of the Building Code of Australia for Residential Buildings – Classes 1,2,4 and 10"
For: The Australian Buildings Codes Board (ABCB)
By: The Centre for International Economics (CIE) – Canberra & Sydney
https://www.abcb.gov.au/Resources/Publications/Consultation/Proposal-to-Revise-Energy-Efficiency-Requirements-for-Residential-Buildings-Final-Decision-RIS

Being mindful of Copyright and in the public and national interest, the following extracts are provided from the section, "12 Conclusion", pages 148-152:

"The analysis has been conducted to estimate the likely net impact on the economy as a whole."
"The findings of the Consultation RIS were that the proposed changes to the BCA, had the potential to deliver a small net benefit to the Australian economy, but the gains were marginal." (pg. 148)

"On balance more uncertainties appear to be raised increasing the likelihood of generating further net costs from the proposal."(pg 151)

"Overall, based on the evidence as it now stands, the proposal outcomes point toward imposing net costs on major growth regions across Australia and a strong possibility of imposing net cost nationally." (pg. 152)

COMMENT
These findings are effectively reiterated in the July 2010 CIE report to Master Builders Australia, further on in the Timeline. The obvious and disturbing question is why did the ABCB proceed to implement 6 Star levels? Was 6 Stars HERS in the public interest, or in commercial vested interests?

2010 – NEWS reports

February 19, 2010 – The Australian (Hedley Thomas)
"Peak body that lobbied for scheme has just two members"

https://www.theaustralian.com.au/news/investigations/peak-body-that-lobbied-for-scheme-has-just-two-members/news-story/aa6213b50db5b820bb6938b5977e4a5a

THE self-styled Australian "Insulation Industry Council" that lobbied the Rudd government to spend $2.5 billion in public money on the botched home insulation scheme is controlled and funded by just two large companies, both of which have enjoyed record sales and windfall profits since the scheme's inception last year.

The Weekend Australian has traced the scheme's inception to high-level lobbying by the Insulation Council of Australia and New Zealand.

ICANZ has received millions of dollars from its two members -- Australian diversified manufacturer CSR and Fletcher Insulation, part of the New Zealand-listed Fletcher Building group of companies -- to lobby governments to use taxpayers' money to subsidise home insulation.

Contrary to perceptions promoted by ICANZ that it was a broad church representing the various interests and elements of the entire Australian insulation industry, the only members of ICANZ are companies owned by CSR and Fletcher Insulation, which have enjoyed a 10-fold increase in business since the federal government scheme began.

CSR, a regular and generous donor to the Labor and Liberal parties, and Fletcher enjoy almost a monopoly over insulation products in Australia, with about 70 per cent of the market for homes. Their most successful products are based on fibreglass.

ICANZ chief executive Dennis D'Arcy is a former marketing manager of an insulation business owned by Fletcher, while ICANZ director Ray Thompson is the current marketing manager for the insulation division of CSR.

Martin Jones, the government relations manager for CSR, confirmed to The Weekend Australian yesterday that CSR and Fletcher fully funded ICANZ and employed Mr D'Arcy and other ICANZ staff.

"The body is representative in terms of the manufacturers, Fletcher and CSR, who are the members," Mr Jones said.

Research reports and submissions flowing from studies funded and managed by CSR and Fletcher have been used by ICANZ to lobby the Rudd government, the previous Coalition government and various agencies -- including the Productivity Commission and the Environment Department -- to start a government-sponsored insulation scheme.

Parts of the reports were adopted by Environment Minister Peter Garrett to justify the unprecedented package announced by Kevin Rudd last February.

In its "About ICANZ" section of its website, there is no disclosure that the only members of ICANZ are companies owned by CSR and Fletcher.

Mr D'Arcy told The Weekend Australian the constitution of ICANZ permitted only manufacturers of fibreglass insulation and the industrial-strength rockwool insulation to be members.

The barriers to entry and the costs of setting up fibreglass manufacturing plants are such that only CSR and Fletcher meet the test.

However, Mr D'Arcy denied ICANZ had been a "closed shop" for the other types of insulation and their makers.

"I make no apology for saying we are a council for the insulation industry. The fact we have two members is irrelevant. It's unfair for anyone to suggest we are misleading the public."

Mr D'Arcy rejected suggestions ICANZ had been deliberately opaque over its representation of the biggest beneficiaries of the scheme.

"Everyone else in the industry has got a free ride out of the work we have been doing and the studies we have put together for the government," he said.

Aluminium Foil Insulation Association vice-president Michel Bostrom accused ICANZ of being misleading by purporting to represent the whole industry while acting only for CSR and Fletcher.

He said ICANZ had also used its commercial muscle to influence official industry standards and building codes to benefit its members.

"They carefully avoid co-operating with us or with anyone else (with insulation products)," Mr Bostrom said.

"They don't want to lend credibility to anyone else because they have 70 per cent of the market tied up."

COMMENT

"Research reports and submissions flowing from studies funded and managed by CSR and Fletcher have been used by ICANZ to lobby the Rudd government, the previous Coalition government and various agencies….."

Today 2019, ICANZ companies continue to have immense influence on the insulation market via Standards Australia, where Standards are referenced by the Federal Government Department, the Australia Building Codes Board (ABCB) who write the National Construction Code (NCC). Additionally, the questionable computer modelling House Energy Rating program NatHERS, has fatal issues in supporting and ensuring "thicker is better" in relation to bulk fibrous insulation products for any climate of Australia via ICANZ, and further flawed by unpredictable 'occupant behaviour'. Of recent times, researchers and the media are more frequently describing new homes as "hot boxes," rather than "ovens" - interchangeable words.

February 25, 2010 - The Australian (Hedley Thomas) - Dr Terry Williamson "Woolly claims on insulation"

Far from cutting energy use, home insulation may cause it to rise.
http://www.theaustralian.com.au/news/investigations/woolly-claims-on-insulation/story-fn6tcs23-1225834522839

October 8, 2010 - The Australian (Hedley Thomas) "Solution isn't rocket science"

Correct energy efficiency outcomes need to be collected before spending $billions on government funded climate change programs. The closing words of the article…….CSIRO is pleading for "evidence-based outcomes".

https://www.theaustralian.com.au/news/investigations/solution-isnt-rocket-science/news-story/5a08625ae43efccbd11d47fbe92c4711

COMMENT

The warnings kept coming in and the government kept ignoring them. Just promote and sell more bulk insulation, without any justification by 'real world' installed performance, and defying the principle of "diminishing benefits' as illustrated by CSIRO in 1981 and 1991 (Timeline).

2010 (May) - Introduction of 6 Star house energy efficiency levels into the BCA & related issues

The ABCB introduced the 6 Star HERS level into the BCA in May 2010, and in light of the official advice in the Regulatory Impact Statement (RIS) by CIE, that 6 Star would likely deliver economic losses.

Increases in Total R-values shifting from 5 Star to 6 Star levels in roofs-ceilings of the BCA, ranged 53-89% depending on BCA Climate Zones 1-8, which permitted installing R5 and R6 fibreglass batts in roofs (Note: polyester batts reputedly cannot be manufactured thicker than R4.5). The staggering jump was unjustified and unproven for either real in-situ thermal improvement, or any economic benefit, as evidenced clearly in this CIE report, and the CIE report for the MBA July 2010.

Additionally, the ABCB has always failed to address and openly discuss:

a) The presence of the 'diminishing returns principle', i.e. insulation levels above a certain point do not
b) provide additional benefit. This well known scientific principle has been discussed previously in 1991 CSIRO insulation bulletin, and 1986 Aluminium Development Council submission to Standards Australia Committee BD-58 (listed in the Timeline).

c) "Heat transfer through building construction has three principal modes: Conduction, Convection and Radiation. The relative contribution by each mode is influenced by the direction of heat flow, i.e. Upwards, Downwards and Horizontally, as well as the intensity of radiation and emissivity of surfaces within the construction, and temperature differences across the construction. These conditions vary widely, over diurnal and seasonal time frames, and need to be considered in relevant standards and general building design and construction."

d) High level radiant heat loads upon buildings.

The prime beneficiary of the 6 Star introduction was the fibrous bulk insulation industry, not the public. In 2010, the insulation industry was reeling in disbelief about the 6 Star levels of insulation. A common anger from insulation installers was that they knew full well that more insulation had no further benefit (see Dr Harkness opinion, Sept 2009 Timeline), and that ceilings would become impossible to insulate around downlights with R6 batts, and make the roof space more dangerous to navigate.

Did the ABCB listen? No, they didn't. The industry and public complaints were totally ignored.

The public have been indoctrinated over decades into believing 'thicker is better', 'more insulation is always better'. The ABCB only liaise with 'stakeholder groups' such as big business associations and powerful lobby groups. The end result is that as the Star ratings rise, so does the amount of bulk insulation, and it's all unvalidated. There has never been any physical validation testing project commissioned by the federal government, rather computer modelling under the NatHERS system that has never accounted for the principals of 'diminishing benefits' and 'building thermal dynamics' which includes impacts of radiation and consequent costs of cooling of houses.

Powerful insulation companies have consistently had an unfair advantage advising on government regulations, and on Australian standards.

The relevant standards committee BD-58 does not have representation from 'Small Business', while the Consumers Federation of Australia, a BD58 voting member, rejects any communication with the public, stating that complaints must be made through BD-58 stakeholder voting bodies. What this effectively means is that the only input the public can make is via an official 'Public Comment' phase prior to any standard being published.

In practice this is a totally useless phase because 'the horse has already bolted' and the final document has been bedded down and will not be changed, as Tim Renouf has frequently expressed to Standards. 'Public

Comment' ought to be at the front and end of Standards' processes. The 'front end' allows the public to have a chance to flag what might be serious flaws in a standard.

2010 (July) – "Energy Efficiency in Residential Buildings: Building Code Star Ratings – What's optimal, what's not"
Author: The Centre for International Economics (CIE) - Canberra & Sydney
For: Master Builders Australia
http://www.thecie.com.au/wp-content/uploads/2014/06/MBA_Report_9_July_2010.pdf

Executive Summary
Optimal star rating is generally around or below 5 *(pg 11)*

Apart from one particular house design with several site advantages, most other typical new designs in most locations have optimal star rating below 6 and many are below 5. These results are consistent with the recent Regulation Impact Statement (RIS) which assessed the benefits and costs of the Building Code of Australia (BCA) being revised to raise the minimum required star rating from 5 to 6 stars. It found that a shift to 6 stars would impose net costs on the Australian economy.
* *The results from the RIS and chart 3 show that the current minimum energy efficiency requirements for new homes are likely to be at, or already past, the optimal level in most areas.*
* *Any future increases in the minimum energy efficiency requirements for new homes will result in larger and larger costs and smaller and smaller benefits. The net cost to the community will therefore increase significantly with each incremental increase in the minimum energy efficiency requirements for new homes.*

Chapter 1 Introduction
"The Issue" (pg. 15)
The economic dimensions of relentlessly pursuing higher star ratings are poorly understood politically and within government. The Productivity Commission has previously expressed concern about how the star rating system is applied. It has also recommended that a detailed, ex post, economic analysis be conducted on the previous decision to move to the 5 star rating. This has not occurred. In addition, the Final Regulation Impact Statement and benefit cost analysis behind the recent decision to move to 6 stars showed that economic losses would be imposed on most states should it be adopted, but the Ministers Building Forum decided to proceed anyway."

Chapter 5 Conclusions *(pg. 41)*

Energy efficiency is usually achieved only at some cost to the economy. Relentlessly pursuing ever higher energy efficiency star ratings in building with no consideration of the costs will inevitably lead to expensive ways to achieve energy savings and reductions in greenhouse gases. Energy efficiency is not economic efficiency. Economic efficiency requires that costs as well as benefits (of energy savings) be considered.

The way that NatHERS star bands are constructed means that the marginal benefit of increasing the star rating diminishes rapidly. The benefits of increasing the star rating beyond about 5 stars are minimal. By contrast, the marginal costs of technologies required to raise a rating above 5 stars escalate rapidly for most house designs in most locations. Forcing home owners to build houses with higher star ratings imposes higher costs (in terms of building resources) than it saves in terms of the value of energy resources. It therefore imposes net costs that are financially damaging to home owners and economically detrimental to the community. It will manifest itself in higher house prices and lower disposable incomes of Australians and it will not result in efficient reductions in greenhouse gases.

For existing homes, potential for economic gain may exist because the marginal benefits are potentially higher than for new homes. For those homes with very low existing star ratings, those with star rating of 1 or below, there is probably potential for an economical 1 to 1.5 star gain.

COMMENT
This CIE report to the Master Builders was written seven months after the CIE had performed the official task of undertaking the Regulatory Impact Statement (RIS) for the consideration of 6 Star House Energy Rating levels. The advice of both reports was that 6 Star levels could not be justified. The obvious question remains – why did the ABCB increase the existing Star rating level from 5 to 6 Star?

2010 (July) - Senate Inquiry – 'Home Insulation Program' (HIP) - Recommendations
http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Completed_inquiries/2008-10/eehp/report/b01

Technical Recommendations 6-11

Recommendation 6
5.23 The government should establish a dedicated and industry-independent program to research insulation systems and help develop efficient and effective insulation policy.

Recommendation 7
5.28 That Standards Australia consider amending its funding mechanism so as to disallow contributions from any stakeholders with a potential commercial interest in any Australian Standard.

Recommendation 8
5.30 That Standards Australia consider reconfiguring its technical committee arrangements to prevent commercial interests from being seen to unduly dominate decisions which should be based on scientific evidence.

Recommendation 9
5.32 Standards Australia consider responding publicly and in detail to the scientific criticisms of AS/NZS 4859.1, and if necessary undertake an independent review of the standard.

Recommendation 10
5.49 The Australian Building Codes Board should consider:
• making public the submissions received during the consultation on the recent changes to the energy efficiency requirements of the Building Code of Australia;
• responding publicly and in detail to the concerns raised in this inquiry, and any related issues raised in submissions to the recent consultation, about the treatment of insulation in the energy efficiency requirements of the Building Code of Australia; and
• explaining the basis upon which BCA has not adopted suggestions that roof/ceiling R-value standards in the BCA (volume 2, table 3.12.1.1a) should include, in warm climate zones, maximum up values for naturally ventilated houses as well as minimum down values.

Recommendation 11
6.26 That the Government form a small advisory group, representative of all of the different components of the insulation industry, to:
• develop and consider policies or measures necessary to maintain a viable insulation industry in Australia;
• consider policies or measures to maximise the energy efficiency for Australia's building stock in safe and measured ways;
• proceed with the necessary research and changes to standards required to provide clarity around the efficiency of different forms of insulation for different climates; and review industry standards and workplace practices to ensure high quality standards across all jurisdictions and rebuild public confidence in the sector.

COMMENT
There were four pro-foil insulation testimonies, three from the AFIA foil association members, as well Dr. Richard Aynsley.
The Consumers Federation of Australia (CFA) gave no evidence to the Senate Inquiry, which is odd considering so many consequences affecting the public flowed from the HIP Program.
There was no response to this Senate Inquiry final report from either Standards Australia or the ABCB, there was no independent review of the key insulation standard, and not reported in the media. The ABCB regularly states that they are independent of Standards, which is false when in fact the ABCB is a voting member of Standards Committee BD-58, and the two bodies liaise very closely together.

2011 – ABCB – Draft Preliminary Impact Statement – Revision of AS 4254 Ductwork for air-handling systems 2002 and Amendments 1+2

No internet record links exist.

Random extracts

Flexible duct deficient of the required thermal values specified in the BCA has been identified as major issue of concern by those within the industry and the AGO. The revised edition clearly defines and refines the thermal testing requirements for insulation used on flexible duct leaving little open to interpretation.

What are the issues and why are they a problem?

…the ducted heating or cooling unit is 2% of the total ducted system, the other 98% of a ducted system is flexible duct. However this important part of the system (flexible duct) is not star rated and left to the installer to make the selection…..

In 2006-2007 an industry group, Australian Duct Manufacturers Alliance (ADMA) was formed at the request of the AGO to assist Government in regulating of the flexible duct industry.

In 2008 ADMA appointed independent consultant (P. Spry) familiar with the industy…..products purported to comply with AS 4254 and AS 4859.1.

In 2009 the Spry report confirmed the AGO's 2006 findings of widespread non-compliance to AS 4254 and AS 4859.1. The report was signed off by the ABCB and DEWHA. (COMMENT: The Spry report revealed that radiative heat effects impacted on cooling ductwork).

It goes against comprehension and all government policy that flexible duct installed into these applications (98% of the air delivery system) does not to comply with any standards or Regulations.

COMMENT

In February 2016 the writer followed by Graeme Doreian, wrote detailed letters to Standards Committee BD-58 demanding to know why radiation impacts upon cooling ductwork had not been addressed in defiance of clear warnings to do so in AS 4859.1 (2002) Amdt-1 (2006), see Timeline.

To make matters worse, when a member of the public complains about a serious issue, and is totally vindicated, Standards Australia do not maintain dialogue with the person making the compliant. In this case, the writer understands that the serious ductwork R-value issue, was redirected for the duct committee to determine a suitable test method.

Like so many energy efficiency issues of legitimate public interest (e.g. "why isn't my airconditioning system working correctly?"), silence reigns from Standards Australia (under the cover of Committee-In-Confidence) and the public are shut out of participating and being thanked when raising extremely serious issues. The result is invariably the same, spanning a raft of Committees – the public left in suspension, doubt and confusion all because they weren't "a stakeholder" holding a Committee vote.

2011 (October) – Condensation in Buildings Part 1 – HVAC & R Skills Workshop

For: ABCB & AIA(Institute of Architects)

https://www.airah.org.au/Content_Files/HVACRNation/2011/October2011/HVACRNation_2011_10_01.pdf

2011 (November) – Condensation in Buildings Part 2 – HVAC & R Skills Workshop

For: ABCB & AIA(Institute of Architects)

https://www.airah.org.au/Content_Files/HVACRNation/2011/November%202011/HVACRNation_2011_10_01.pdf

Part 2 - extracts

Consequences of condensation

The failure to consider condensation within the built environment can have serious consequences arising from both surface and interstitial condensation. Some of those consequences include:

• visible and hidden fungus and mould growth
• sick building syndrome leading to serious health problems
• timber decay
• phantom leaks
• saturation of insulation and loss of insulation effectiveness
• corrosion
• loss of structural integrity
• health and safety risk arising from slippery floors

Transient methods

The basic steady state models do not take into account factors considered by more complex transient calculations that model dynamic changes within the construction throughout the year at intervals as short as one hour, depending on availability of climate data. There are transient models that consider some or all of the following factors:
• any moisture that remains in the structure from the construction stage that has not dried out
• the variation in material properties such as thermal conductivity that depend on moisture content
• latent heat that is released/absorbed by condensation/evaporation.
• capillary suction and liquid moisture transfer within materials
• air movement through or within the building elements through cracks and in air spaces such as cavities and roof spaces
• the hygroscopic capacity of materials
• boundary conditions that are not constant over a month and change on a daily and hourly basis.
• The effects of solar and long-wave radiation
• the drying out of built-in moisture.

COMMENT

Both documents provide a concise technical explanation of a very complex subject, and are highly recommended reading.

2012 (Oct & Nov) AIRAH 'Ecolibrium' – Condensation in Residential Housing (Richard Aynsley F.AIRAH)

Aynsley, R. Condensation in Residential Buildings Part 1: Review, October 2012
https://www.airah.org.au/Content_Files/EcoLibrium/2012/October%202012/2012_10_01.pdf
Aynsley, R. Condensation in Residential Buildings Part 2: Hygrothermal Analysis, November 2012
https://www.airah.org.au/Content_Files/EcoLibrium/2012/November%202012/2012_11_01.pdf

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Part 2 - Extracts:

Energy-efficiency requirements in the Building Code of Australia were introduced in the 1990s. A number of changes occurred in brick veneer walls in Melbourne and western Sydney between 1970 and 2011. A typical 2011 brick veneer wall had 90mm stud framing, housewrap over the studs and a 90mm R2.5 fibreglass batt insulation. But few builders or designers bothered to analyse the implications of these changes on the risk of condensation.
In hindsight, a hygrothermal analysis in Table 2 suggests condensation will occur behind

CONCLUSION

A couple of decades ago mould on interior surfaces due to condensation in buildings was rare. Recent increases in thermal insulation for energy efficiency and utilisation of air conditioning in Australian houses, has resulted in increased risk of condensation in winter in temperate climate regions and summer in humid tropical regions if hygrothermal analysis including ventilation is ignored.

Obtaining vapour-resistant properties of materials used in Australian house construction can be problematic. Much of the existing vapour resistance data are from Europe, measured at temperatures well below most Australian in-service conditions. Reliable water vapour resistance data at in-service are needed from Australian building material manufacturers.

Australia needs a standard on moisture control in buildings that reflects the huge span of latitude of the country. ASHRAE Standard 160 (ASHRAE 2009) offers some useful indications on how to deal with condensation risk in cold, temperate and tropical regions. Without an Australian standard for assessing condensation risk, there is no consensus on what are appropriate input data, hygrothermal analysis methods, or evaluation of results. Without such a standard, assessment of condensation is a matter of opinion.

COMMENTS

To the best knowledge of the writer, these two technical papers on Condensation in 2012 were the first occasion in Australia that a relationship was revealed between formation of condensation and increasing levels of thermal insulation stemming from mandatory rises in House Energy Ratings in the BCA-NCC.

These Aynsley papers are essential primary reference reading documents.

These papers led to Dr Aynsley being given AIRAH's 2013 'W.R. Ahern Award', and were key referenced documents in the 2016 Tasmanian Condensation study by Univ Tasmania, Dr Tim Law & Dr Mark Drewsbury, the forerunner study which triggered the national Condensation Scoping Study (Sept 2016). The 2016 study recommended Australian research before any solutions or strategies were decided. No research was undertaken between September 2016 and the introduction of the NCC May 2019, which saw foil sarkings banned in walls for Climate Zones 6,7,8 and breather membranes mandated. This was negligent behaviour of the ABCB (see all Timeline links). Furthermore, the writer has attempted to source BRANZ Appraisal performance evidence for Australian application, and none is forthcoming.

One course of action that the ABCB has consistently refused to discuss or contemplate, and which resonates through this Timeline, is what would happen if insulation levels in walls were reduced backwards to say a simple double-sided foil wrap with 'breathing' air chambers on either side? The answer would be, very likely, no condensation. This action could be also justified by the 'Law of Diminishing Returns', the first amount of R-value provides the greatest amount of resistance.

W.R. Ahern Award 2013

The W.R. Ahern award is awarded annually and recognises the best technical paper by an AIRAH member published in Ecolibrium in the preceding year.

Winner: Dr Richard Aynsley, F.AIRAH, for his paper "Condensation in residential buildings," which was published in the October and November 2012 issues of Ecolibrium.

L-R: AIRAH CEO, Phil Wilkinson, M.AIRAH, and award winner, Dr Richard Aynsley, F.AIRAH.

2012 – "A Comprehensive Review of Radiant Barrier Research Including Laboratory and Field Experiments"

Author: Marion Medina - Assoc Prof, Dept Architectural Engineering, Univ Kansas, USA
http://www.insulationstop.com/resources/comprehensive-review-radiant-barrier-research-including-laboratory-field-experiments.pdf

INTRODUCTION

The increased pressure to reduce energy use and lower the electrical peak demand that result from building operations have encouraged the increased use, and sometimes the excessive use, of insulation. Although building insulation has played an essential role in making buildings more energy efficient, the amount of insulation that can be added to an attic space is limited by the physical dimensions of the structure. Extra insulation can potentially obstruct attic ventilation, compress itself, and create an excessive weight on the ceiling structure.

Attic Radiant Barriers (RBs) present a different way of increasing the thermal performance of existing or to-be-installed insulation in the space between roofs and ceilings of buildings (e.g. attic spaces in residential buildings or the space between roofs and suspended ceilings in commercial buildings). RBs have received considerable attention because of their potential to reduce radiant heat transfer across vented spaces between roofs and ceilings of buildings. RBs are metalized films or aluminium foil sheets laminated to paper (most commonly to Kraft paper), polymer films, oriented strand board (OSB), or plywood. These films and laminates are characterized by having at least one surface with an emittance of 0.1 or less (ASTM C 1313 2010). In the case of RBs, aluminium is used because it is inexpensive and because its surface, once exposed to air, becomes covered with a layer of a transparent oxide that protects it from the atmosphere and allows it to maintain a low emittance for long periods of time.

CONCLUSIONS

There is ample evidence in the literature to conclude that radiant barriers reduce the heat transfer rate across attic spaces in a significant manner. This reduces the space cooling load and to a lesser extent the space heating load. Reductions in ceiling heat flow were primarily affected by RB emittance values, the level of insulation in the attic, and climate. The data indicate that, on average, radiant barriers reduced summer ceiling heat flows by approximately 23 to 45%, depending on the insulation level……

COMMENT

This USA report provides an a concise explanation of the testing and thermal benefits of a range of aluminium based radiant barrier systems in American style attic roof spaces. It is provided to illustrate that Australian house and roof construction has many differences and further justification for the need to establish an Australian thermal testing research station to cater for the wide variety of Australian building construction design techniques and materials.

2013 (January) – "Thermal Performance Evaluation of Attic Radiant Barrier Systems Using the Large Scale Climate Simulator (LSCS)"

Author: William Miller PhD, Som Shrestha PhD, Andre Desjarlais – ORNL Oak Ridge Laboratories, USA
Published by: ASHRAE 2013
Sponsored by: The 'Building Technologies Program', US Department of Energy (DOE)
https://www.solec.org/wp-content/uploads/2018/02/Radiant-Barrier-IRCC-Performance-Report.pdf

Notes:

1) In the USA, all foil insulation products and materials are referred to as '*radiant barriers'.*

2) Large Scale Climate Simulator (LSCS) is a climatically controlled room, with an array of mounted lights on the ceiling of the room producing replicated and variable radiation loads.

3) This experiment used a pitched roofing assembly made of fully encased timber (with venting), and tested three different low-e aluminium insulation materials at roof level, combined with 3.5 inch (90mm) R2.3 fibreglass batt insulation on the ceiling. Conducted in 'steady-state' replicated hot conditions.

Extracts:

ABSTRACT

Application of radiant barrier and low-emittance surface coatings in residential building attics can significantly reduce conditioning loads from heat flow through attic floors. The roofing industry has been developing and using various radiant barrier systems and low-emittance (low-e) surface coatings to increase energy efficiency in buildings: however, minimum data are available that quantify the effectiveness of these technologies.

This study evaluates performance of various attic radiant barrier systems under simulated summer daytime conditions and night time or low solar gain daytime winter conditions using the large scale climate simulator (LSCS). The four attic configurations that were evaluated are 1) no radiant barrier (control), 2) perforated low-e foil laminated oriented strand board (OSB) deck, 3) low-e foil stapled on rafters, and 4) liquid applied low-emittance coating on roof deck and rafters. All test attics used nominal R2.29 m2K/W fibreglass batting insulation on the attic floor. Results indicate that the three systems with radiant barriers had heat flows through the attic floor during summer daytime condition that were 32.8%, 49.8%, and 19.1% lower than the control, respectively.

INTRODUCTION

Among the various modes of heat transfer, radiation is the predominant mode of heat transfer in typical building attics, particularly during summer months. Therefore, the use of radiant barriers or low-emittance (low-e) surface coatings in residential building attics can significantly reduce conditioning loads from heat flow through attic floors. In order to determine the effectiveness of various radiant barrier systems, the Building Envelope Research (BER) group within the Building Technologies Research and Integration Center (BTRIC) at ORNL conducted a series of steady-state guarded hot box evaluations in the large scale climate simulator (LSCS) from May to August 2011. Results are presented in this paper.

SUMMARY

*Implementation of radiant barriers is becoming more prominent in building codes, like California's Title 24. The US Department of Energy conducted elaborate tests at the large scale climate simulator at ORNL. The purpose of this testing was to evaluate the performance differences in new construction and retrofit applications, as well the performance differences between the radiant barrier sheet and the radiant barrier paint, also known as interior control coating (IRCC)…***results revealed in ABSTRACT**……*The heat flow through the attic floor decreases with higher insulation R-values or during milder weather conditions. Therefore, for attics with higher insulation R-values the potential savings due to the application of radiant barrier systems will be lower than the results shown in this study……*

The DOE was hopeful that the IRCC paint would offer better performance since spraying on IRCC is easier than installing a sheet radiant barrier once the house is built., but the IRCCs on the market today do not perform well as a sheet radiant barrier…….

The most efficient method was the radiant barrier stapled on rafters. This particular experiment did not have HVAC ducts in the attic; homes with attic ducts could see even greater savings in summer. Radiant barrier stapled on the rafters is the preferred method of installing a retrofit radiant barrier by the US Dept of Energy, ENERGY STAR, California Title 24, ASTM International, and others.

FUTURE WORK

The experimental work data can be used to calibrate an attic model developed in any building energy simulation software. The calibrated model then can be used to run an annual simulation with local weather data and calculate annual energy savings potential of the various radiant barrier systems and attic insulation level for various climate zones.

For this study, the exterior of the roof temperature was held fixed in all attic configurations for a given climate condition, which would not be exactly the same if the test was conducted at natural environmental condition. Therefore, further experimental study should be carried out in natural exposure buildings.

<u>COMMENT</u>

The outstanding result the double-side low-e foil membrane fixed to the underside of the roofing rafters at 50% heat flow reduction, compared to low-e laminated foil OSB board at 33%, was likely due to the OSB example having no upper functioning airspace (acting for high reflectivity) as did the stapled foil.

These USA research report findings have themes that are mirrored throughout the Timeline, posing the obvious question, of why isn't such research pursued in Australia? And particularly considering the pressing

requirement for the NCC to develop strategies for 'heat resilient buildings' for human survival as well as energy reductions.

In the Timeline, 2013 NCCRF "A Framework for adaptation of Australian households to heat waves", revealed how bulk insulations under high loads have unreliable R-values, as well as advocating the use of reflective insulations and reflective roofs.

The simple answer is that the ABCB, the national NCC regulations and the array of Scoping Studies and Preliminary Impact Statements (PIS), invariably have one common theme - to ignore and suffocate any consideration of any form of real house physical testing aided by physical climate simulation (such as ORNL). The ABCB will not conduct open public discussion on whether Australia requires a dedicated independently run national building testing facility, as recommended in the findings of the 2010 Senate Inquiry – HIP.

The relevance of this report to Australia is enormous; the 90mm/R2.3 bulk insulation tested in ceilings is very likely to be applicable to vast regions of Australia requiring winter heating. Refer to the historic Timeline entries of 1975, 1981, 1991 advising such R-value levels. Then add the overwhelming fact that Australia is a continent of higher and longer radiant heat loads compared to that of North America and Europe, and the clear-cut case is for the expansion of reflective foil insulations.

2013 - "A framework for adaptation of Australian households to heat waves"
NCCARF – National Climate Change Adaptation Research Facility – Univ South Australia
Author: 23 authors including Prof John Boland (Univ SA) & others *242 pages
Contribution partners: Dept Climate Change and Energy Efficiency, SA Govt, Uniting Care Australia, AIRAH
https://www.nccarf.edu.au/publications/framework-adaptating-australian-households-heat-waves

Selected quotations:

Abstract & Executive Summary (pgs 1-4)
Climate change is leading to an increased frequency and severity of heat waves. Spells of several consecutive days of unusually high temperatures have led to increased mortality rates for the more vulnerable in the community. The problem is compounded by the escalating energy costs and increasing peak electrical demand as people become more reliant on air conditioning. Domestic air conditioning is the primary determinant of peak power demand which has been a major driver of higher electricity costs.

This report presents the findings of multidisciplinary research which develops a national framework to evaluate the potential impacts of heat waves. It presents a technical, social and economic approach to adapt Australian residential buildings to ameliorate the impact of heat waves in the community and reduce the risk of its adverse outcomes.

The research has demonstrated that a combination of responses are necessary to adapt to heat waves and to reduce its risks including behaviour change during heat waves as well as the need to reconfigure house design and the use of air conditioning.

Those on lower income and elderly individuals are the least able to afford the use of energy for air conditioning and should be a priority for interventions and assistance.

Recommended actions included:
** Climate data used in NatHERS and air conditioning design calculations must be adjusted to reflect a changing climate.*
** The most effective methods for reducing the cooling demand for existing dwellings is to modify their roofs by increasing their total solar reflectance, adding reflective foils and increasing thermal insulation.*

5.3 Impact of Design Options on Cooling Energy (pgs 145,146)
In the last decade, consideration has also been given to the reflectivity of solar radiation from the roof and the impact of reflective foils. Less bulk insulation is required with roofs which reflect more solar radiation, such as light-coloured roofs and those who have foil applied.

According to the BCA, the thermal resistance or R value of bulk insulation is based on AS/NZS 4859.1:2002 which requires measurement of the R value at 23degC. However, no consideration has been allowed in the BCA for the degradation of the R value due to temperature. As stated in AS/NZS 4859.1:2002, the R value can degrade……during peak summer…..A fixed R value is also applied in AccuRate.

…..The absorbed radiation (of a roof) is a function of the total solar reflectance (TSR) of the roof….
Roof surfaces which absorb high amounts of solar radiation can readily reach temperatures of 80degC in hot weather. This temperature represents the driving force of the heat into the building.

The dominant form of heat transfer in roofing systems in summer is through radiation. Reflective foils are very effective in reducing this heat flow……and reduces the temperature of the insulation itself, maintaining the R value. Overall, these features enhance the reliability of the roofing system at reducing heat flow, particularly during extreme hot weather.

5.12 Conclusions (pg 170)
NatHERS accredited software tools such as AccuRate, are very comprehensive and powerful building thermal models. Heat flow through the roof represents the dominant building load in peak summer. Assumed performance of insulated roof in these thermal models is unreliable, and research has shown that the thermal resistance or R value of the roofing system can be as low as half that of the R value of the bulk insulation.

The application of roof heat flow reduction measures such as applying a high TSR roof and the use of foil in combination with the likely performance of insulation is able to deliver significant savings, reducing annual air conditioning electricity consumption by 18% on average across Australia. This saving translates to reduction in running costs.

7.2 Improvements to Building Design and Regulation (pg 206)
Although a number of measures can reduce peak cooling demand, the single most effective options relate to reducing heat flow through the roof. Research and field measurements have shown that current regulations and installation practices relating to bulk inbsulation do not achieve the expected thermal resistance of roofing systems……therefore consideration should be given to correctly rating insulated roofing systems in NatHERS and the BCA as well as implementing quality assurance systems, which would bring Australia in line with leading OECD regulations. Thermography is a common low cost tool used for assessing insulation in buildings. In absence of these measures, de-rating the thermal R value of bulk insulation in roofing systems should be considered in any peak cooling analysis.

An effective and reliable measure of reducing heat flow through the roof is the application of roofing colours which deliver a high Total Solar Reflectance (TSR), as well as the use of reflective foils in combination with bulk insulation.

COMMENT

This NCCARF report makes devastating revelations regarding hot roofs, regarding the impact of high radiation energy loads upon bulk insulations, as well as the great benefits of using reflective insulations.

This report appears to be the only definitive government funded report openly advocating the thermal need of reflective foil insulation in roofs to lessen the impact of radiation upon residential buildings, and the very first and only official report to discuss 23degC being the base condition that all bulk insulations are tested at.

The writer Tim Renouf, has spoken and written letters about this issue since 2002 when the standard was first issued to agencies, Standards Australia and an extensive number of politicians, with very little support. The silence from the Consumers Federation of Australia has been appalling.

Note: 23degC is actually the 'mean' of two temperature plates set at 33 & 13 degC with bulk inserted between, and it's a 4 hour test, obviously not representative of a typical Australian roofs in hot climates.
The falsehood is compounded when certain bulk insulation companies make printed claims that the product performance is 'guaranteed'.

Standards Committee BD-58 and the ABCB appear to have completely ignored the array of historic research on, and recommendations for, reflective insulations, and particularly this NCCARF report.

Since the first (2011) and second (2014) ABCB 'Condensation Handbook', foil insulations have been targeted as the culprit for condensation formation when, since 2004 the adoption of 5 and 6 Star HERS levels has paralleled with significant increasing levels of bulk fibrous insulation and increasing air tightness of dwellings.

Fortunately, this NCCARF report states that less bulk insulation and greater solar reflectance is the way ahead. Nobody dares name the elephant in the room – this strategy might just reduce the risk of condensation! Why? Because aluminium foil insulations have been used successfully in roofs of houses (combined with R2.5 bulk in ceilings) in Australia from 1952 up until around 2004 with no reported condensation issues.

Of course, the whole story is compounded by bulk insulation industry interests having full editorial control of the revision of the full suite of insulation standards. And such interests are motivated by one main issue: selling higher and higher R-value levels of fibre-based insulation materials. This is an illustration of Committee imbalance and 'capture', explained further (see Standards Australia 'Governance Review' April 2018).

Additional Univ SA reports reinforce the need for reflective foil insulations under roofs, see Timeline 2017 (October).

2012/13 – Standards Committee BD58-ABCB attempt for mandatory RFL foil sarking in residential roofs

This action was started then quickly abandoned, with no explanation ever given. Tim Renouf was the AFIA foil association liaison person working with the counterpart foil membrane association PBMA, controlled by ICANZ. A reasonable conclusion was that the project was abandoned because it was a threat to selling higher R-value levels of bulk insulation.

2013 (June) – AIRAH Technical Handbook - Edition 5

The Australian Institute of Refrigeration, Air Conditioning and Heating (Inc)
*Major technical reference document

Extracts:

Section 3: Heat transfer, thermal properties and insulation
Ventilation of building envelope (pg 47)
Radiant barriers should be included whenever radiation is a problem. This includes all of Australia. The reflective side must be be used in conjunction with an adjacent still air space (or two adjacent air spaces if double sided). Often one side is semi-reflective ("anti-glare") and may have a reduced infra-red emittance.

Section 6: Heating, Ventilation and Air Conditioning
Natural ventilation (pg 163)
Naturally ventilated buildings should have insulation in the building envelope, in particular radiant barriers below the roof, in walls and suspended floors, to minimise radiation heat transfer. Shading is also desirable in warm to hot climates; and orientation to allow sun penetration in cold climates.

COMMENT
This major technical document highlights how essential foil radiant heat barriers are vital for any hot climate situation. The TIMELINE documentary evidence mounts that houses should be encased in aluminium foil insulations, with accompanying airspaces.

2013 (October) – Australian Ductwork Manufacturers Alliance (ADMA) support to foil insulation industry

Full support was given for mandatory foil in residential roof spaces, with a letter in writing addressed to Tim Renouf of the first foil association AFIA, to provide radiant heat control benefits for roof space airconditioning ductwork.

Background situation: fibrous insulations around cooling ductwork are assessed at only 23degC 'mean', and cannot resist high temperature radiation, when roof spaces are commonly 50-70degC in hot climates spanning Australia. The ADMA endorsement letter was based on the accompanying foil sarking performance report St.Regis-ACI 1968-69 (in this Timeline).

2013 (Dec) – "The Evaluation of the 5-Star Energy Efficiency Standard for Residential Buildings"

https://www.energy.gov.au/publications/evaluation-5-star-energy-efficiency-standard-residential-buildings

For: Federal Dept Industry, Innovation & Science

Authors: Ambrose, James, Law, Osman, White – CSIRO

The CSIRO was contracted to evaluate the effectiveness of the 5-star energy efficiency standard for houses introduced in 2006, compared to the previous 3.5 to 4 star standard. Their work has culminated in this report, 'The Evaluation of the 5-Star Energy Efficiency Standard for Residential Buildings. It is the first evaluation of energy efficiency standards for houses in Australia based on comparison of actual energy use in a large sample of houses. This comprehensive report has added to our understanding of how well energy efficiency star ratings in residential buildings actually work, for homeowners and builders alike. The study monitored the energy use of more than 400 houses (with around half the houses undergoing more detailed monitoring of heating and cooling) in Brisbane, Melbourne and Adelaide, from June 2012 to February 2013.

Summer cooling energy use (pg 16)

Energy consumption was increased in summer in houses with higher star ratings in Brisbane and Melbourne……the summer results may have been confounded by the following two factors: (i) cooling equipment running at full capacity during the particularly hot 2012-2013 summer months……(ii) it was not possible to reliably assess the levels of ventilation being used in the houses. More measurements and a more detailed analysis are needed to resolve these two issues.

COMMENT

Yet again, the call for further research, gets ignored. Basically, this CSIRO study was flawed from the outset by 'occupant behaviour' and that it didn't record or reveal what types of insulation existed in the homes examined.

This link below from the 2014 Royal Commission - Home Insulation Program, by Graeme Doreian, sums up the deception of the Federal Government via their Department CSIRO to justify the Star ratings 5, and 6. CSIRO could not follow basic scientific principles while spending over a million dollars of taxpayer's money. Read DOR 0020010036 - 0041

http://www.homeinsulationroyalcommission.gov.au/Hearings/Documents/Evidence15April2014/DOR.002.001.0028.pdf

More wasted taxpayers money – the government will not fund a comprehensive house testing program.

2014 (August) - Royal Commission - Home Insulation Program (HIP)
http://www.homeinsulationroyalcommission.gov.au/Documentation/Documents/ReportoftheRoyalCommissionintotheHomeInsulationProgram.pdf

Forensic examination of all aspects of the HIP program, from maladministration, lack of due diligence in program roll out, failure to act on safety warnings by public servants, and multiple program abuses including rorting of funding and theft.

The massive defence of foil insulation was undertaken by building energy advisor Graeme Doreian & Tim Renouf, who were two of only seven people who gave voluntary statements to the Royal Commission, and they were also selected to give in-camera oral evidence.

The foil association AFIA (to which Tim Renouf belonged to at that time) gave no evidence to the Royal Commission.

The Consumers Federation of Australia (CFA) gave no evidence.

During the HIP, foil insulations rapidly became 'the whipping boy' (words used in Renouf testimony) and blamed as a roof space electrical risk. Evidence was presented by Graeme Doreian that there were decades long abuses of, and non-enforcement of, the Wiring Rules (AS/NZS 3000-2007) which revealed rampant and flagrant practices of laying electrical cables over the tops of ceiling joists, which were then a risk for damage by human activity in roof spaces. This was openly ratified by in-camera evidence by Master Electricians Australia (MEA).

Forensic documentary research by Doreian and Renouf running through 12 editions of The Wiring Rules 1931 – 2014, revealed a clear pattern of cabling safety instruction in roof spaces – that cables are meant to 'mechanically protected' and not capable of being damaged, i.e. stood on, crushed, pierced or tripped over.

Over time the most common method of cabling protection evolved to be, clipping cables to sides of joists 50mm down from the top.

Had electrical cabling been correctly installed, there would have been no opportunity of cabling damage in the HIP program to occur. The vast extent of non-conforming cabling was the cause for the 2014 Royal Commission to have no choice but to recommend reflective foil be banned from being fixed in ceilings. Loose fitting unstapled Foil Batt style products were exempted, and described as being an 'entirely different level of risk' compared to sheet form RFL products stapled to tops of joists, and confirmed by the MEA.

The electrical abuses triggered the first major sustained assault against foil insulation industry, exploited by certain industry players to weaken the case for reflective foil insulation use in houses. Interestingly, up until the 2009-2010 HIP, there were no reported electrical safety issues with reflective foil insulations in Australia since their commencement in 1952.

The second assault against foil insulation came with the changes in the NCC 2019 'breather' membrane regulations revealed first in February 2019.

Footnote: The 2014 Royal Commission was aware of the highly combative nature of the insulation industry and the tension regarding insulation product performance claims.

2014 (October 2) FIFTH ESTATE: "Frustration with NatHERS sparks new verification body"
https://www.thefifthestate.com.au/innovation/rating-tools/industry-frustration-with-nathers-sees-new-body-spawned/

This story reveals significant failings of NatHERS and its administrator, the gap between designed and built performance, and the setting up of an alternate body called the Building Verification Council.

And the pattern through the Timeline continues – where is the hard data of real energy used in houses compared to the building designs and levels and types of insulation used?

2014 (November) – NEEBP 'National Energy Efficiency Building Project' - Pitt & Sherry
http://pandora.nla.gov.au/pan/150449/20150211-1805/www.sa.gov.au/__data/assets/pdf_file/0004/135544/NEEBP-final-report-November-2014.pdf
Prepared for: Dept of State Development, Govt of South Australia
Funded by: federal and state governments
Detailed investigation into the reliability of house energy ratings.

Appendix C
Townsville workshop (pgs 199, 200)
Key observations:
The Townsville workshops were strongly attended by local government, residents, and non-government organisations with small representation from the building industry.

There were several clear themes evident in the discussion of the Townsville workshop. The first focussed on the success local government had achieved in observing and communicating the benefits of light reflective roofing in Townsville. The ability (or lack thereof) of local government to mandate white roof requirements in the planning process was highlighted as a simple measure toward addressing energy efficiency in the tropics.

When discussing the building industry, participants highlighted the fact that components can often be installed incorrectly (e.g. roof insulation), but that builders see a competitive edge in installation techniques and therefore won't share knowledge with competitors. A similar theme which was observed in the Brisbane workshop surrounded a strong perception that the building industry is willing to accept cheaper building components over quality design. Furthermore a link was drawn to the consumer knowledge/awareness, and that unless a consumer specifically requests energy efficient housing or building components, builders will not supply it.

Finally the majority of participants agreed that 'you can't manage what you can't measure'. This view was two-fold, the first relating to building performance and needing to have real-time usage feedback in place to understand how a building operates under different conditions. There was a common agreement that there needs to be examples of what energy a house or commercial building consumes. The second view related to the expected performance of building components (e.g. appliances) and the need to understand how they perform in terms that consumers understand (e.g. a new fridge will cost a household the equivalent of 2 cheeseburgers a day to operate rather than kWh).

Perhaps one of the most consistent items of discussion was around the lack of applicability of the BCA to workable and comfortable tropical buildings. The important role of the local strategy of reflection of heat through radiant insulation, backed up by air movement to provide evaporative heat loss, is at odds with the focus on sealed and bulk insulated buildings in the code driven designs. Sealed and bulk insulated buildings are seen as simply not workable in the tropical climate. This different response to a different climate creates anomalies like a tendency to install multiple radiant heat barriers in roofs, but no bulk insulation above the ceiling and, in some areas, installation of combination insulation (foil backed thermal blanket) upside down to ensure trapped condensation does not cause corrosion (a problem which simply does not occur in cooler and less humid climates). A building with two layers of reflective sarking in a

ventilated roof cavity - and no bulk insulation above the ceiling - does not rate highly in many assessment tools or schemes but works well in the tropics. An interesting anomaly is the commercial focus on small blocks where legislated clearance from fences leads to creating eave-less houses in order to squeeze in more floor area. This is anathema to comfortable housing in the tropics, yet is supported by (some) rating tools and systems. Such conflicts appear to have (rightly or wrongly) significantly eroded trust in the BCA's energy provisions.

Appendix E
Survey Findings
Knowledge of energy efficient building materials (pg 230)
Many respondents reported that clients (especially residential) prefer conventional materials and designs with which they are familiar, and that construction tradespeople lack experience in installing innovative materials and alternate construction systems. There can be risk in using unfamiliar and untested materials. One respondent characterized this view within the construction industry as … "We don't want to be the leader, we want to be an early adopter". Respondents also reported that builders are reluctant to bear the cost of training in new energy efficient construction systems and materials.

Many respondents also reported that few energy efficient materials are tested for local conditions and that there is insufficient access to materials samples. Respondents frequently reported that material suppliers do not have the right information available and do not understand designers' technical information requirements, or climate zone needs. Some designers reported some material suppliers as "pushing 'climate wrong' products" due to their lack of understanding and desire to make a sale. Some respondents were also concerned that inappropriate use of materials was counterproductive and damaging to the broader reputation of energy efficient materials and policy aims in this area. Some respondents felt there is a need for local "warts and all case studies". Some respondents servicing tropical regions were particularly concerned with the appropriateness of energy efficiency materials for their climate.

Summary of Findings (pg 239)
Across all states and territories other than NSW and Tasmania, 50% or more respondents rejected the notion that industry had confidence in the energy rating tools.

COMMENT

These report sections have been, and remain to be, ignored by the ABCB and Standards Committee BD58.

It is relevant to repeat again that national insulation standards are written by Industry, mainly the fibrous bulk insulation sectors who have editorial control of standards, and refuse to discuss this NEEBP report or any other report presenting a pro-foil and anti-bulk perspective in relation to insulation performance in hot climatic environments.

The Insulation Industry refuses to respond or react to the NEEBP report (and many other reports), made worse by the inaction of the ABCB who is a participating-voting member of the Standards Committee, who will not compel the bulk industry to respond. The situation is made worse because the house energy raters also will not ask any questions about bulk insulation suitability in dominant hot climates, as they probably plug in the stated product R-value assuming it is dependable.

The bulk insulation industry historically promote and publicly declare that their products are suitable for use in all climates, with one company claiming "guaranteed performance for 70 years", when very clearly they are not, after reading the Townsville Workshop findings.

And with 50degC temperatures predicted to be more frequent for Adelaide, Sydney and even Melbourne, the point of breaching the public interest has arrived. Industry cannot keep writing standards unless there is real-time controlled thermal testing for Australian climatic conditions, undertaken to validate insulation R-value product claims, applying to both bulk and reflective foil insulation materials. An independent review of standards, as recommended in the 2010 Senate Inquiry HIP is required.

2015 (January)- G. Doreian correspondence to ACCC: Free fibreglass batts to Birdsville QLD

On 22 January 2015, Graeme Doreian forwarded an email with concerns regarding Knauf Insulation providing free bulk insultation for Birdsville to federal Minister Bruce Billson federal MP (responsible for Small Business & ACCC) who then forwarded directly to ACCC.

May 26 2015 The ACCC wrote to G. Doreian with a reply to Jan 22, 2015 email. The ACCC confirmed that it had informed Knauf Insulation, and summed up *"should ensure representations about the performance characteristics of its product are not misleading and can be substantiated. This office does not intend to pursue this matter further."*

2015 (March 15) - FIFTH ESTATE: "Insulation – the problems, the scapegoats and why the Building Code needs amending"
https://www.thefifthestate.com.au/innovation/building-construction/insulation-the-problems-the-scapegoats-and-why-the-building-code-needs-amending/
This story included interviews with Tim Renouf (Wren Inds), Graeme Doreian (energy efficiency consultant) and Dr Richard Aynsley.

The opening words sum up the tension in the Industry:
"Last year's Royal Commission into the Home Insulation Program has the insulation industry at loggerheads, and emotions are running high. What might seem a basic technical matter of managing thermal comfort is anything but simple, with industry experts telling The Fifth Estate about issues as diverse as shonky electrical wiring practices, questionable industry lobbying, energy assessment methodologies that don't match reality and marketing that ignores the difference between the cool states and the tropics."

2015 (March 15) - FIFTH ESTATE: "Insulation – how to make the right decision"
https://www.thefifthestate.com.au/innovation/building-construction/insulation-how-to-make-the-right-decision/72343/
Interview with Dr Richard Aynsley and Tim Renouf (Wren Inds).
This story and the comments that follow are worth reading in its entirety, as so many issues are covered.

2015 (July) – Publication of AS 3999 (2015) "Bulk Thermal Insulation – Installation"
Revision of AS 3999 (1992).
Produced by: Standards Australia (Committee BD-58)

Like all standards, no internet link can be provided to the standard as they have to be purchased, even in the face of repeated recommendations for standards to be made free since 2006.

All standards are meant to be revised after 10 years, and this one was 13 years overdue. In 2009 for the rapid roll out of the Home Insulation Program (HIP), there was no time to consider a revision, and the insulation industry simply allowed the old version to be adequate. The 1992 standard naturally made no mention of installing any foil insulations, and therefore the HIP had no guidance whatsoever as to how foil laid in ceilings would be installed (in the HIP, foil was permitted in ceilings in dominant hot climates only).

Due to the problems caused by using an outdated Installation standard in the HIP, and electrical abuses discovered from the HIP, a quick amendment to the 1992 standards occurred, followed by a major revision which took about three years to complete. Nevertheless, AS 3999 (2015) has structural errors and has ignored many basic scientific principles of heat flow dynamics and the well known principle of 'diminishing returns'.

There have been long term regulatory plans, considered by all states under COAG, for mandatory disclosure of energy use in residential buildings, and the adoption of AS 3999 (2015) would be needed to accompany the primary insulation standards 4859.1 & 4859.2 (2018), to facilitate this. Many states are not supporting the proposal, and rightly so, as there is a high risk of legal challenge would follow, because thermal performance of insulation materials is highly contestable due to the string of a fatal flaws running through the full suite of insulation standards, as they are 'not fit for purpose'.

2015 (September) – ABCB Project Management Brief "Scoping Study – Condensation in buildings"
Version 5 – Date 21/09/2015
Senior Responsible Officer: Matthew McDonald
Project Manager: Heather Nielsen

This is the formal initiating document to commence the condensation-breather membrane changes to the NCC 2019, and is no longer available by the internet which appears to be the common pattern of the ABCB to make any search of historical processes literally impossible. The obvious question is why does the ABCB do this?

Selected extracts (not the full BRIEF):

1. INTRODUCTION
Background
Anecdotal evidence received has indicated increased condensation in residential buildings. This scoping study is needed to explore the issue further particularly in relation to the application of the NCC.
Project objective
By undertaking a scoping study, develop recommendations for the Board on the role of the NCC for the mitigation and risk reduction associated with condensation in residential buildings.
Nature and extent of the Problem
Australia has increased regulation for energy efficiency of residential buildings three times over the last 10 years, and there are relatively new requirements for homes built in bush-fire prone areas. There is a possibility that this has impacted on the likelihood of condensation forming in dwellings due to the improved sealing of buildings and other measures…….(and) if the problem is occupant behaviour then building codes are limited in how they can manage this potential problem.

2. PROJECT SCOPE (selected points only)
* Informal consultation with relevant external experts as needed.
* Consultation with internal ABCB Office Technical staff.
* Consideration of residential Class 1 and Class 2 building construction
* Consideration of work already undertaken in Tasmania and New Zealand.
* Development and delivery of a scoping paper by undertaking a literature review, and gathering of information from industry/experts and a national survey….
* Identification of groups of relevant stakeholders to respond to survey…..
* Participation in industry workshops on condensation in buildings.
* Recommendations to the Board for further work (if needed), based on the outcomes of the scoping paper.
* Development of solutions (regulatory or non-regulatory) for any recommendations to the Board e.g. DtS Provisions for inclusion in the public comment draft of the NCC 2019….
* Consultation on the scoping study

3. TIMEFRAMES
** Identify industry academic experts & contact*
** Liaison with industry/academic experts*
** Identify relevant stakeholders for survey (Oct 2015)*
4. RESOURCES
5. COMMUNICATION PLAN

Industry/academic experts in condensation – provide project background & plan, project updates to help inform their advice
** Industry – awareness that a project exists*

6. RISKS
** Limited time of technical staff and experts to provide input into the scoping paper – Risk Level = LOW*
** Limited time of technical staff and experts to provide input into the scoping paper – Risk Level = LOW*

7. CONSTRAINTS
Recommendations to the Board are due mid-June for 2016-2 meeting

COMMENT

This document provides the hard evidence that the ABCB:

i) did not consult the entire insulation industry, in particular the foil insulation industry

ii) did not consult the best qualified academic experts - e.g. Richard Aynsley PhD, the 'first identifier'

iii) did not make the whole industry 'aware'

iv) did not undertake 'further work' - further Australian research was recommended in the final 'Condensation Scoping Study' Sept 2016, but never started and apparently ignored. WHY?

v) time to get the job done was 'limited' and considered LOW RISK – there was 7 months between the completion of the Tasmanian study and the national study, an unrealistic timeframe at breakneck speed all in the name of meeting the NCC Timetable for 2019 publication

See Timeline 2018 (Feb) - Public Comment DRAFT NCC 2019 – Released Feb 2018
https://cdn2.hubspot.net/hubfs/4043727/NCC_BCA_2019_Volume_One_Public_Comment_Draft_V1_2.pdf?t=1542686850436
Page 228 reveals the introduction of breather membranes in walls for Climate Zones 6,7,8. The majority of insulation industry did not know what was planned (even though publicly released for comment in Feb 2018), and reading DRAFT NCC documents is a technical jungle that requires an expert to navigate and discover salient information. The writer himself and the majority of foil insulation industry became aware of the full impact of the planned NCC changes only in February 2019.

2016 (Feb) – Tim Renouf private letter to Standards Australia - Committee BD58 – Ductwork performance
https://www.afica.org.au/wp-content/uploads/2019/11/Letter-Tim-RenoufWren-Inds-to-Standards-Committee-BD58_Failure-of-flexible-cooling-ductwork-in-residential-buildings-5-Feb2016.pdf

A request in writing was made by the writer Tim Renouf, in a private capacity, to Committee BD-58, in the course of the major review of AS/NZS 4859.1(2002), to account for radiation impact upon flexible cooling ductwork insulation in hot residential roof spaces of 50-70degC, whereby chilled air transiting slowly through the duct gains temperature rapidly as radiation penetrates the fibrous insulation material around the circumference of the duct. This is because the test method for all bulk insulations in any situation (including ductwork) is a laboratory test set at 23degC 'mean' temperature, for a duration of only four hours. The visible external jacket of shiny foil sometimes seen is not providing additional thermal performance because it is not foil laminate – it is the type of foil lining the interior of food packaging.

The letter was written in the public and national interest, because the foil association AFIA gave no support to questioning ductwork insulation performance, saying it was "not within the jurisdiction of Committee BD-58".

As a result of the Renouf letter, Committee BD-58 first had to determine where thermal responsibility for ducting lay - they finally decided that it was within BD-58's jurisdiction, and then referred the matter of duct test methodology to the ductwork committee to decide an actual physical test method. As stated earlier in the Timeline, the ducting performance has been in question since the AGO meeting in 2006 and earlier in 2011 (Timeline – 2011 ABCB Preliminary Impact Statement).

The writer has no idea what final test method the duct committee will decide on; the expectation is that the committee will decide to do nothing, and maintain the international test method (ie 33 & 13 degC testing plates, averaging 23degC), precisely the same test method for all bulk insulations across the world for any climatic condition, which is self-evidently misrepresenting product in-situ performance.

Line this up against what was stated in the 2013 NCCARF Univ SA report (see above) that, in relation to bulk insulations, *'no consideration has been allowed in the BCA for degradation of the R value due to temperature'.* And the warnings given to the ductwork industry in 2009 that roof space radiation impacts had to be accounted for. It should be an open and shut case – do the correct physical research. **The need for insulation 'real time' research testing keeps on repeating.**

If Standards do not or will not enforce realistic radiant heat load assessment through Australian roof spaces, this will be a complete abuse of the public interest, the public who have no capacity to understand what is written in highly technical insulation standards, referenced by compulsion in national regulations, and will ultimately be potential grounds for action under ACCC Trade Practices, e.g. with 45-50degC days.

Refer this section together with 2006 Ductwork performance/AGO meeting, where the ACCC declared the 'insulation was on the radar of the ACCC'.

2016 (Feb) "Investigation of Destructive Condensation in Australian Cool Temperate Buildings"
Author: Dr M.Drewsbury & Dr T.Law – UTAS, Univ Tasmania
Funded by: by Building Standards & Occupational Licensing, Dept Justice Tasmania
https://www.researchgate.net/profile/Mark_Dewsbury/publication/301895039_Investigation_of_destructive_condensation_in_Australian_cool-temperate_buildings_Appendix_1/links/572c31ee08ae2efbfdbde133/Investigation-of-destructive-condensation-in-Australian-cool-temperate-buildings-Appendix-1.pdf
(copy and paste to browser)

This report analysed the effects of moisture and moisture control in buildings in Tasmania, as well as the consequences of vapour-impermeable and unventilated building envelopes, namely platform floors, external walls, roof spaces and infiltrations.

Selected recommendations (pg 6)
*Until better information is available, all buildings in Tasmania, which may be heated, should use vapour permeable building wall wraps.
*minimum ventilation requirement for all attic spaces in Tasmania
*provide a written guide for building and related professions explaining guidance on vapour management within Tasmanian buildings.
*lobby the ABCB about the lack of regulatory requirement on design and construction practice to manage vapour pressure and minimise risk of interstitial and internal condensation within the current NCC.
*develop within 2-4 years a software based condensation simulation tool, integrating NatHERS climate files.

2016 (Sept) ABCB "Scoping Study of Condensation in Residential Buildings"
Dr M.Drewsbury & Dr T.Law – UTAS, Univ Tasmania
Funded by: ABCB
MAIN REPORT
https://www.researchgate.net/publication/317399171_Scoping_Study_of_Condensation_in_Residential_Buildings_Final_Report_23_September_2016
APPENDIX 1 Terms of Reference
https://www.researchgate.net/profile/Mark_Dewsbury/publication/317399415_Appendix_1_Project_Terms_of_Reference_Scoping_Study_of_Condensation_in_Residential_Buildings_Final_Report_23_September_2016/links/5938be93aca272bcd1a00c7f/Appendix-1-Project-Terms-of-Reference-Scoping-Study-of-Condensation-in-Residential-Buildings-Final-Report-23-September-2016.pdf
APPENDICES 1-8 Complete record
https://abcb.gov.au/Resources/Publications/Research/Scoping-Study-of-Condensation-in-Residential-Buildings-Appendices

Overview

This report is the national extension of the Tasmanian project Feb 2016, and is based predominantly on overseas data. The writer understands that local Australian data for hot humid and tropical climates has not been collected and analysed, and that a request was made to the ABCB by Graeme Doreian in April 4, 2019 for the entire nationwide Australian house data to be provided.

No response was forthcoming. A second request was made on May 7, 2019 and no reply. Then on May 14, 2019 a third request was sent to Neil Savery ABCB and others, and a reply finally arrived May 28, 2019 which apologised for not getting back to the earlier emails, then followed a polite 'get lost', did not answer the specifics and danced around of what they the ABCB had done and what they intend to do. The full emails record is available upon request.
In other words, we don't fully understand what the Scoping Study was based on, other than overseas data, which probably explains the final report request for 'additional research in the Australian context'.

Report extracts:

Acknowledgements *(page 2)*
Extensive collaboration occurred with

- *CSR Building Products*
- *BRANZ*
- *Australian Institute of Architects*
- *Building Surveyors*

Quote (pg 24):
'Therefore, as now recognised by the ABCB…..
"Increasing levels of insulation and air tightness are changing the underlying building physics, less energy flow through the building fabric also means less moisture flow, so when the fabric gets wet, it is likely to stay wet longer. These circumstances suggest that condensation management strategies based only on established expectations, rules of thumb or narrow margins of safety are unlikely to stand the test of coming decades. (ABCB, 2016a)" '.

Quote (pg 32 & 33):
Application in the Australian context
The considerable amount of international research into condensation causes and potential mitigation strategies provides the opportunity to draw on previously established viable solutions. Australia has a diverse range of climatic conditions and building typologies. However, the literature on condensation is comprehensive, ranging across all major climate types. The research from these other developed nations is also highly specific. They have tested very particular variables in building systems to determining responses to specific issues.

As a result, Australia does not need to reinvent the wheel. Considerable evidence-based research has already been conducted on a wide range of climate and building type responses to condensation. Any recommended solution or strategy should be tested before being implemented in the Australian context…."

COMMENT

There has been no Australian condensation research testing program proposed by the ABCB since the September 2016 national report, and the introduction of the NCC May 2019 (see Timeline), which saw no-breather foil sarkings banned in walls for Climate Zones 6,7,8 and breather membranes mandated. This was unexplained and negligent behaviour of the ABCB, because major commercial damage has occurred.

Furthermore, the writer contacted BRANZ of New Zealand to see if any BRANZ Appraisal had been undertaken for breather membranes use in Australia, considering that CSR Building Products were the primary consultants to the Study. BRANZ replied that contact would have to be made with CSR directly. No confirmation by CSR.

Condensation testing must be undertaken in 'Dynamic State' and extended time frames, beyond the constriction of fixed time duration 'Steady State' conditions.

2016 – "DA20 Humid Tropical Air Conditioning - Application Manual" – 3rd Edition
Publisher: AIRAH - The Australian Institute of Refrigeration and Heating
Review Group: Vincent Aherne M.AIRAH, Richard Aynsley F.AIRAH, Phil Wilkinson F.AIRAH, and others
https://www.airah.org.au/ItemDetail?iProductCode=DA20

Copyright – restricted to AIRAH Members (no public website access available)
An astonishing and most significant technical manual to assist in cooling design for the tropics.
(refer also Timeline – 1987 Gove Peninsula NT, catastrophic failure of vapour barriers)

Random extracts:

2.9 Condensation risk analysis
A condensation risk analysis is carried out by calculating the temperature profile through the composite construction and should be carried out for walls, roofs and insulating systems for building services. The risk of condensation in the humid tropics is greatest when outdoor air has a high dew point and a relatively high BDT (dry bulb temperature) when being exposed to low temperature surfaces such as metal frames…..

2.11.2 Insulation materials
Insulation materials can divided into two broad groups "bulk" insulation used predominantly as……

2.11.6 Roof insulation
Many buildings in the tropics have the vapour barrier (reflective foil) placed on the incorrect side (the inside) of the roof bulk insulation (mineral fibre)…..the vapour barrier should be on the outside of the insulation not the inside face…..and then it is recommended that a layer of perforated reflective foil is used on the inside face…to allow any moisture that has penetrated the 'external' vapour barrier to continue unimpeded into the conditioned space.

3.2 Passive design strategies
Passive design can improve the internal conditions of buildings that are not air conditioned and can significantly reduce the cooling loads of buildings that are to be air conditioned……

The following are all important passive building design strategies for buildings in tropical climates. The application of these strategies reduces cooling loads and improves comfort in the building:
…..solar orientation…ceiling fans…quality ceiling insulation reduces downward heat flows…..low-e glazing….lightly coloured external surfaces….eaves….externally shaded windows east and west….shade trees east and west….low mass construction will cool quicker at night but may heat up quicker at during the day……cooling breezes to be encouraged such

as wing walls…..reflective insulation should be used with other insulation materials to decrease the absorption of heat…..a continuous vapour barrier encompassing the building if the building is to be air-conditioned.

3.4 Effects of tropical climate conditions
3.4.1 Solar radiation
The peak solar radiation in the tropics is not necessarily higher than in temperate climates…..however, because of the year round high sun angles, the tropics experience much longer periods of high solar radiation.

3.5.1 Roofs
The roof of any building is exposed to a greater heat load from solar radiation than any other part of the building…..
Most under-roof insulation comes with foil facing as a vapour barrier and to provide the reflective/low emission insulation effect.

3.8 Comfort system selection
3.8.1 Low energy comfort
The hierarchy of systems from an energy use perspective is:
1. Ventilative cooling – Lowest energy use.
2. Evaporative cooling – Higher energy use, power used by fan and pump.
3. Refrigerative cooling – Highest energy use, power used by compressor, fans and pumps.

3.16 Controls and comfort
…….a typical setback temperature is 27degC. Care needs to be taken that the resulting internal condition does not lead to the room air dew point temperature being higher than the internal surface temperature which would lead to condensation and mould growth.

COMMENT

In hot humid climates, whether a dwelling is conditioned or unconditioned (i.e. free running / naturally ventilated), reflective insulation materials must be used in roof-ceilings, based on the downward facing low-emissive properties. In walls, a single layer of double-sided foil insulation is sufficient, alone.

This AIRAH DA20 Manual provides technically sound thermal and vapour movement advice to an advanced level, but such advice is devoid in any literature from 99% of insulation manufacturers, since the early 1990s. The reason is wilful, calculated and deliberate. Reflective insulations based on aluminium laminate (not aluminium coatings) provide outstanding continuous resistance to incoming solar radiation, with adjoining airspaces, as this entire Timeline demonstrates.

The ABCB in the NCC does make references to concessions given for reducing radiant heat loads by the existence of a table of differing roof colours. But what the ABCB refuse to do is to enforce in standards technical mechanisms to account for high radiation levels in standards, predicted to hit 50degC with increasing frequently in Sydney and Melbourne, thereby assisting in making buildings more 'heat stress resilient' (see Timeline 2013 NCCARF report), and ensuring the regulations are soundly based and 'fit for purpose'.

In the Timeline 2019 (July), the NCC has now introduced separate cooling and heating loads into NatHERS, which are unfathomable (as usual with many ABCB decisions) and is akin to re-arranging the deck chairs on Titantic. The HERS rating system has been on life support for years and most industry people know this. The suppression of facts is so advanced so that the public are stranded in ignorance and are generally dependent on cooling advice from the builder, architect-designer or the insulation and air-conditioning industry.

Good luck with that, because the saturation belief is that bulk insulations solve all problems in any climate – which is pure insanity and illogicality (think of car windscreens using foil shields, not blankets). Fortunately, the 2016 AIRAH DA20 Manual rather bursts the bubble and spells out the situation pretty clearly.

There is also a slew of other evidence, such as from building designers who know that in the tropics, for roof-ceilings, reflective foils are preferable to bulk insulations because they also facilitate rapid night time cooling (i.e. low resistance upwards), which bulk most certainly cannot do (i.e high resistance upwards). It's not only the writer saying this, it's the designers (see Timeline 2014 NEEBP report).

2017/18 – Tim Renouf communications to SA Committee BD-58 regarding the obliteration of all pre-existing 'environmental warning clauses' in revision of AS/NZS 4859.1 (2002)

Clause 2.3.3.2 Test Protocols, includes the accounting for *'temperatures that affect heat flow', and 'radiant energy level…and radiation penetration through insulation materials that have some transparency to infra-red frequencies'.*

Clause 2.3.1 General, states *'…Thermal resistance refers to the in situ or in-service condition. It is the intent of the methods and procedures contained in this Standard that the measured and/or declared thermal resistance shall reflect as accurately as possible the performance encountered within buildings.'*

The major revision of 4859.1 intended to and has jettisoned the above requirements, and substituted this with the continuation of selling any bulk insulation material at 23degC for any climate of Australia, and in any building construction, with variable temperature testing optional.

Tim Renouf complained to SA Committee BD-58 because the foil association of which he was a member was not informing its members as to what was happening inside of Committee BD-58. Additionally, SA ignored 2001 AGO guide manual (see earlier Timeline), and the 2014 NEEBP findings (see above). In other words, the independent foil insulation industry was not fully aware of what was unfolding in the Standards Committee.

2017 (October) - "Heat stress-resistant building design in the Australian context"
Univ SA – Hatvani-Kovacs, Belusko, Pocket, Boland
Funding by: CRC for Low Carbon Living, and Australian Government initiative
https://www.sciencedirect.com/science/article/pii/S0378778817307648?via%3Dihub

Abstract
…….This paper demonstrates that the NatHERS does not directly encourage heat stress resistance in new homes and can even deliver buildings with worse heat resistance and increased reliance on air-conditioning than traditional, energy inefficient buildings. This overreliance on air-conditioning can present a public health hazard, consequently, the integration of heat stress resistance in the Nationwide House Energy Rating Scheme is recommended.

Further quotations
……high levels of insulation and air-tightness can foster overheating in summer without a comprehensive design leading to both energy efficiency and heat stress resistance….features include shading, more reflective roof colour, reflective foil in the roof….
Further research is warranted to investigate the impact of the NatHERS on heat stress resistance in the Australian climate considering Australian building practices.
Although air-conditioning is acknowledged as an efficient, preventative measure for health problems, it also has several negative impacts…..AC can cause a reverse adaptation effect where people become acclimatised to AC and., therefore demand lower temperatures to achieve comfort.

COMMENT

Reflective foil recommended for residential roofs, yet again, after Univ SA first advised this in its major report, and noting that Prof John Boland was a co-author of two reports, above as well as:

2013 - "A framework for adaptation of Australian households to heat waves" NCCARF – National Climate Change Adaptation Research Facility – Univ South Australia (refer Timeline).

The reader could easily ask the obvious question: *"when will the ABCB act, and mandate reflective foil insulations for all roofing of residential buildings?"*

2018 (February) - Public Comment DRAFT NCC 2019 – Released Feb 2018
https://cdn2.hubspot.net/hubfs/4043727/NCC_BCA_2019_Volume_One_Public_Comment_Draft_V1_2.pdf?t=1542686850436
*private link only, no official ABCB links exist any more to the DRAFT

Page 228 reveals the planned introduction of breather membranes in walls for Climate Zones 6,7,8. The insulation industry substantially did not know what was planned, and reading DRAFT NCC documents is a technical jungle that requires an expert to navigate and discover salient information.

Most of the insulation industry were not aware of the full impact of the planned NCC changes until February 2019 when the first indication was announced by CSR Bradford technical bulletin. An argument will be put that the industry had the chance to comment on the PUBLIC DRAFT, but the condensation changes were extremely well hidden in the massive NCC DRAFT, it would have been easy not to know.

2018 (April) – "Technical Governance Review Report – Standards Australia"
For: Standards Australia (SA)
Author: Cameron, Ralph, Khoury
REPORT
https://www.standards.org.au/getmedia/8f14c324-1e71-4f9a-8479-2b9937280941/2018_0404_SA_TGR_Final_Report.pdf.aspx
Highly useful to read the entire brief report, and to better understand the impact of vested interests on Committees. The Technical Review was largely an expansion of the Productivity Inquiry into Standards Australia in 2006, and the earlier 1995 Keanne report.

Extract:
Proposed reform directions
B. More open processes
To enhance transparency and accountability, there should be better public reporting about the progress of a standards project e.g. via publication of committee minutes.

RESPONSE by STANDARDS AUSTRALIA
https://www.standards.org.au/getmedia/ba5e7fb0-c844-49b0-abd7-aa49124fb418/TGR-Response-to-Final-Report.aspx

Extracts:

2. Committee Composition
B. More open process
Standards Australia to, on a pilot basis:

1. *Open up community access to information about Technical Committee membership and contribution by publishing information about members and their interests.*
2. *Supplement existing constituent based representation with additional expert and community based contribution.*

3. *Look at and trial different contribution models to balance constituent based representation with expert contribution.*
4. *Actively manage the balance of committee representation to increase diversity in all areas of activity.*
5. *Track outcomes of projects and continue to evolve the open model to achieve a balance of openness and constituent based representation.*

C. More proactive quality assurance
As a second pilot project for committee composition, Standards Australia to:

1. *Identify skills, knowledge and experience requirements in a particular area.*
2. *Build committee membership on an invitation basis around the skills requirements.*
3. *Appoint members based on technical, regulatory and public policy merit, and community impact.*
4. *Make publicly available records of meetings and decisions made as part of the development process*
5. *Make the process transparent to nominating organisations and other constituent based representatives.*
6. *Track outcomes of projects and continue to evolve the open model through post project dialogue and assessment from all affected stakeholders.*

COMMENT

This was an extensive independent review of the entire operation of SA, with a very wide range of interviews. Important recommendations included:

i) greater public participation to the development of standards, and public access to all Committee documents and minutes of meetings, which has not occurred.
ii) greater balance of representation and expertise on technical committees.
iii) to lessen the possibility of 'Committee Capture'

In April 2018, SA agreed to virtually all the recommendations. Additionally, the Standards' CEO openly admitted at a Melbourne public forum (April 2018) that 'Committee Capture' was a possibility that had to be avoided. Unfortunately, SA has not acted on most of the findings.

In the opinion of the writer Tim Renouf, the most necessary step is to make the work of Committes more transparent, and release publicly Minutes of Meetings, and all tabled documents

2018 (August) – Senate Inquiry – "Current and future impacts of climate change on housing, buildings and infrastructure"
https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/CCInfrastructure/Report

Extracts: pgs 85-91

Need to reconsider minimum building requirements

6.38 Several submitters highlighted that existing building standards prescribed in the NCC are not suitable for extreme climate events associated with climate change. For example, the NCCARF submitted:
Much of Australia's housing stock does not meet existing building standards and can be poorly designed for extreme climate events (e.g. heat, cyclones). Building guidelines currently use historic climate conditions to evaluate the energy demand and performance of a building, and these are unlikely to be adequate for future climate conditions. We do have a reasonable understanding of design features that can target heat reduction (e.g. orientation, shading, provision of appropriately sized eaves, light colours, reflective roofing, inclusion of a cool refuge, complimentary landscaping) but these are not formalised into the National Building Code.44

(44 - NCCARF submission 28 *refer Timeline 2013 - "A framework for adaptation of Australian households to heat waves" NCCARF – National Climate Change Adaptation Research Facility – Univ South Australia)

6.45 The study recommended that heat stress-resistant measures should be implemented in NatHERS to 'decrease risks associated with the population's dependence on [air conditioning], ensure a thermally safe indoor environment and reduce pressure on electricity prices'.51 Further research into Australian building practices and how the NatHERS affects heat stress resistance was also suggested.52
(52 *refer Timeline 2017 October - "Heat stress-resistant building design in the Australian context")

Work currently underway and need for further research

6.55 The ABCB is also undertaking work and monitoring developments in this area. The Chief Executive Officer of the ABCB, Mr Neil Savery, explained that the Board 'continues to monitor events and the science of climate change to determine if any further changes to the NCC are warranted'.65

6.58 Although the ABCB is having regard to heat stress issues as part of its energy efficiency work, Mr Savery nonetheless emphasised that there is no project in the ABCB's work program at present 'that is specifically related to heat stress'. Mr Savery further added that if the energy efficiency project does not sufficiently address the issue of heat stress, then it would be proposed to the Board that additional work be undertaken; however, this would mean that any changes subsequently identified that met the COAG regulatory requirements could not commence until the 2022 revision of the NCC.68

6.61 The HIA warned against changes to how the NCC and relevant Australian Standards are developed. The HIA observed that ensuring 'residential and commercial buildings are resilient to natural hazards is not a new concern'.70 In the HIA's view, the building industry and existing processes for updating the NCC and relevant Australian Standards are well placed to respond to any challenges climate change might present. In particular, the HIA emphasised that the current process requires any proposed changes to be 'evidence-based and be informed by Regulation Impact Analysis in accordance with COAG principles'.71

pg 174:

Recommendation 9

1.30 That the Australian Government request that the Australian Building Codes Board develop minimum requirements for the National Construction Code that are specifically designed to address heat stress risks associated with internal temperatures.

1.31 To facilitate the development of amendments to the National Construction Code, it is further recommended that the Australian Government provide funding for research into:
• how overheating in highly rated energy efficient dwellings can be created where there can be inadequate ventilation; and
• the behaviour of building occupants during heatwave periods.

Recommendation 10

1.32 As part of the research into the full range of social and economic costs associated with heat stress called for in recommendation 7, estimates should be developed of the potential health system savings and other benefits that could be realised through enhanced building standards. In particular, the research should consider the benefits associated with retrofitting low efficiency dwellings to keep internal temperatures within safe ranges during extreme heat events.

Senate Hansard - oral evidence 22-3-18 of Neil Savery CEO - ABCB
https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;db=COMMITTEES;id=committees%2Fcommsen%2F9d5467f4-6a91-4e60-b196-702d02bbacc4%2F0003;query=Id%3A%22committees%2Fcommsen%2F9d5467f4-6a91-4e60-b196-702d02bbacc4%2F0000%22
*the entire evidence of Mr Savery given to the Senate Inquiry is recommended reading.

Random extracts:

Mr.Savery: *In regard to heat stress—which, I was informed through the invitation that I received, is an issue of particular interest to this committee—the 2014 paper that has just been circulated to you identified heat stress and hail as two climate change impacts that had, at the time, not been addressed in the NCC. Further work was undertaken by the ABCB to establish the feasibility of looking at these two issues, which concluded that hail would be too difficult to address through minimum performance standards, given its highly localised and variable characteristics, but also that the primary purpose would be property protection, not occupant health and safety. Heat stress was considered an area where further analysis was warranted, which resulted in its consideration as part of the board's current work in updating the NCC's energy efficiency provisions for 2019. This draws a strong correlation between improving the performance of a building's energy efficiency with providing a more comfortable environment for occupants in extreme temperatures. This includes the introduction of split heating and cooling loads, as part of the proposed changes for NCC 2019, to improve the passive performance of buildings in extreme temperatures as well as reduce greenhouse gas emissions from artificial heating and cooling.*

In concluding, in their 2013 report entitled A framework for adaptation of Australian households to heatwaves, Saman et al proposed a number of retrofitting and new dwelling design features—including cool retreat rooms, reflective roofs, increasing thermal insulation, ceiling fans, improved air-conditioner selection—in combination with behavioural change that, collectively, would reduce the risk of heat-related deaths and household energy costs. No single factor on its own is capable of achieving this adaptation, but, taken together, they would enable Australia to adapt to the challenge posed by the likelihood of increased heatwaves. Further energy efficiency work, which ties in software tools such as NatHERS and BASIX, is anticipated to be undertaken for the NCC, moving forward, which, subject to the modelling from the current work, may result in the consideration of additional cost-effective measures.

XXXXXX

CHAIR: *Very difficult. So what level of resilience will there be, and what level of reliance on air-conditioning will there be, under the new code through that presumption that the air-con is going to be there, rather than accounting for situations where it may not be there?*

Mr Savery ***:*** *On the basis that we're still operating at 6-star, which was introduced in 2010, then there is going to be an expectation for the features that are predominantly the subject of contemporary design—this is for mainstream domestic construction. And, as I said, the NatHERS software builds in an assumption that at a certain point, or over a certain temperature, there is going to be artificial climate control. On the basis that we're now eight years on from the introduction of 6-star, and I anticipate that we will be doing work for 2022 to look at the next generation of energy efficiency within the National Construction Code—which will still be at the minimum level—then I think you may well find that there are other features that come into that.*

XXXXXX

CHAIR: *Do you think that by incorporating heat stress it's actually going to change some of your energy efficiency standards as well? We heard evidence of the problems of energy efficiency that mean you end up with a heat box. Although it's meeting your energy efficiency standards, it's not actually good for the design, in terms of heat stress?*

Mr Savery : *But I think it's important to stress at this stage that we are not working specifically on the subject of heat stress. There is no project in our program that is specifically related to heat stress. In the development of our energy efficiency work we are having regard to heat stress, whether or not that work helps to address that issue. If it doesn't, then there's going to be a discussion around whether there are any other measures that we need to factor in to try to deal with this particular issue? Also, just in terms of heat boxes, one of the changes we made—well, it wasn't so much a change to NCC 2016; it was more a clarification in the form of guidance documents and advisory notes—for the northern climates, which is both the whole of the Northern Territory but also northern Queensland and northern Western Australia, was to overcome some myths around the construction of buildings in those climate zones, where designers were taking it that they had to essentially seal their buildings to meet the 6-star requirements of the code, which wasn't ever expected or required. In fact, it was the complete opposite; it was about promoting natural ventilation.*

CHAIR: *To clarify, you're saying you're looking at your energy efficiency standards and then you will assess how well they deal with heat stress.*

Mr Savery : *Yes.*

CHAIR: *What will happen then, once you've done that assessment, if the assessment is that it's not adequately addressing the issues of heat stress?*

Mr Savery : *We have said to the board that what you've just outlined is the approach. When we get to the end of that process, if we believe there are residual issues where energy efficiency doesn't sufficiently address the issue of heat stress, then we would propose to the board that additional work needs to be done. What that would be saying is that measures in regard to energy efficiency cannot on their own address the issue of heat stress, and therefore there are other measures beyond energy efficiency that we have to have regard to.*

CHAIR: *What is the time line of that process likely to be?*

Mr Savery : *Given that we haven't been given policy direction at this stage, but I anticipate that we will be, I would expect that that is over the next three years, for the purposes of NCC 2022. Now, even if we had policy direction today, that doesn't guarantee that those measures will feature in NCC 2022, because we have to go through the COAG regulatory process. And if we can't demonstrate net societal benefit and all the other objectives I referred to earlier, then there's the prospect that some of those measures don't end up being featured in the code.*

COMMENT

Mr Savery's admission that sealing up houses for northern Australia was never the intention of the ABCB, is good to hear but debatable, because NatHERS was premised on conditioned houses right from the beginning in 2003, and that then lead (presumably) to the justification for outrageously high insulation R-values in the roof-ceiling (as discussed earlier in Timeline) with 6 Star in 2010.

The way forward

The ABCB needs to direct an immediate independent review of the residential building energy efficiency provisions, and referenced insulation standards. The goal ought to be demonstrated 'evidence-based' solutions to repair the regulations, specifically the reflection of radiation impact, and consequent lowering of energy required for artificial cooling, or natural ventilation.

2018 - Graeme Doreian correspondence with ACCC: misleading bulk insulation advertising

During late 2018 G. Doreian forwarded further emails regarding misleading bulk insulation advertising to the ACCC. On Oct 3, 2018 the ACCC responded to G. Doreian, part quote below contradicts what the ACCC instigated in May 26, 2015 above.

> It is important to note from the outset that the ACCC does not have primary legislative or regulatory responsibility for building activity or building products. We do not have a role in assessing the conformance of building products to standards or the National Construction Code, their suitability for use in construction, or the revision or creation of standards that regulate building products.

The above ACCC statements are contradictory, considering 12 years prior in 2006 at a Greenhouse Office meeting the ACCC was a driving force to push investigations into failing ductwork performance contributed to bulk insulation around the ducts.

2018 (Oct) – "Report on the Inquiry into Biotoxin-related Illnesses in Australia" (Federal Parliament)
*Investigation into Condensation & Mould health risks
https://parlinfo.aph.gov.au/parlInfo/download/committees/reportrep/024194/toc_pdf/ReportontheInquiryintoBiotoxin-relatedIllnessesinAustralia.pdf;fileType=application%2Fpdf

Terms of Reference
The Standing Committee on Health, Aged Care and Sport will inquire into and report by 21 October 2018 on:
1. The prevalence and geographic distribution of biotoxin-related illnesses in Australia, particularly related to water-damaged buildings;
2. The prevalence of Chronic Inflammatory Response Syndrome (CIRS) or biotoxinrelated illness in Australian patients and the treatment available to them;
3. The current medical process of identifying biotoxin-related illness in patients and the medical evaluation of symptom complexes attributed to biotoxins and CIRS;
4. Any intersection with other chronic diseases;
5. Investment in contemporary Australian research to discover and provide evidence of CIRS as a chronic, multisystem disease;
6. Research into biotoxin-related illness caused from water damaged buildings; and
7. Any related matters.

List of Recommendations (7 in total)

Recommendation 2

The Committee recommends that the Australian Government work with the states and territories to conduct further research into, and develop standards and/or accreditation requirements for the mould testing and remediation industries, which should include consideration of:

- *the most effective methods of testing and remediation of buildings affected by mould and/or moisture;*
- *appropriate accreditation requirements for professionals working in these fields; and*
- *options for greater regulatory oversight of these industries.*

Recommendation 4

The Committee recommends that the Australian Government work with states and territories to conduct further research into the adequacy of current building codes and standards related to the prevention and remediation of dampness and mould in buildings.

INQUIRY Submissions: Submission 75 – Dr Tim Law, PhD - Architectural Scientist
https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/BiotoxinIllnesses/Submissions

Dr Law co-wrote the two Condensation reports (listed above in the Timeline), and in 2017 had left Univ Tasmania, and must have felt very strongly to make his Submission in a private capacity, personal website www.archsciences.com.au. Submission 75 is essential reading to better understand a complex subject, and conveys a desperate and passionate plea for further research. The submission was substantially referenced in the Parliamentary Inquiry final report.

Extracts (pgs 25 – 28)
*CIRS-WDB = Chronic Inflammatory Response Syndrome in Water-Damaged Buildings

Further research

The Committee has commenced an inquiry into biotoxin illness, this itself is a momentous step to address a

national problem, and I applaud you in that. I would like to suggest that if the parliamentary inquiry can be accompanied by a research inquiry, it would make for a more successful outcome.

Even before the inquiry commenced, the Committee would have been aware that the medical community has had doubts whether biotoxin illness, or CIRS, was a medical entity. There is a gap between a condition occurring, and a condition being recognised. Where there is no recognition, research funding is unattainable, and data will remain scant, if any. We would all like to have answers, but answers need research, and research needs funding.

You need to be aware that under the current research funding regime, CIRS will not be researched into, based on the opinion that it lacks sufficient scientific credibility. The problem is, that without research, it will continue to be regarded that way. The lack of research, and the unwillingness to fund research, maintain a joint stranglehold to keep a hidden illness invisible. As such, we cannot rely on the current funding bodies and institutions to provide the answers.

Yet without a systematic and statistically representative sample, the inquiry will only have anecdotal answers to the terms of reference coming from personal submissions. There is a need for the Committee to provide research funding so as to obtain robust and representative data to the matter you are inquiring into, as part of the report that eventually gets tabled in parliament.

As opposed to research that is specialised, the nature of this research is extremely generalised in that it involves broad interdisciplinary effort, yet targeted in that it focusses on the impact of WDBs on health. In order to understand the significance of this problem, there is a need to bridge three distinct disciplines and uncover the interactive mechanisms between three profiles: the building profile, microbiological profile, and occupant health profile. Buildings need to be understood in the building physics of psychrometry and vapour management from design to construction. This physical environment needs to be studied with its impact on the biotoxin producing micro-organisms and their effect on human immunology.

Concluding thoughts

Condensation is a complex and systemic process in buildings, and poses serious health repercussions. Many of the complexities cannot be understood by a single discipline — we need a multidisciplinary approach. Condensation and subsequent mould growth appears to be a longstanding problem with indications that it might have been recently exacerbated in Australia by increased air tightness and thermal differentials that resulted from the construction industry's response to increased energy-efficiency and bushfire legislature, and also increased market-driven demands for thermal comfort. The competitive building industry has led to inadequate consideration of vapour management at the design stage and improper installation during construction. Although there is acknowledgement of the condensation problem, there is widespread reluctance by any party from the construction or healthcare sectors to take a decisive and categorical position. US photographer, Thilde Jensen, travelled across her country to document people who had extreme chemical and electrical sensitivities. Her photobook, aptly named The Canaries (Jensen, 2013), documents the stories of people who have had to make extreme adaptations to continue living in their houses, or have had to live in car, caravan or tents away from civilisation. Most people with CIRS also manifest a measure of either, or both, sensitivities. Her work is a visual insight into a world we do not often encounter, of what a CIRS patient has to similarly endure with when buildings fail them. The following figures 34–36 illustrate her work.

I trust we all can empathise with the loss. In the iconic 1997 Australian movie The Castle the protagonist says, "It's not a house, it's a home. A man's home is his castle… You can't just walk in and steal our homes." There is due indignation when one is robbed of his own home. Water damage threatens to do exactly that. The irony with condensation is that this was far more infrequent before energy efficiency standards pushed for higher thermal performance. The insertion of sustainability considerations into the mission of the ABCB now appears to challenge the prior objectives for safety, health and amenity. In extreme cases, these new houses can become uninhabitable within their first winter. When one in three Australian houses can trigger one in four people to have a chronic inflammatory response, we need to rethink if we had been too preoccupied with one sustainable development goal and completely forgotten that the house is our home, our castle. It is ultimately supposed to be a place to feel safe and healthy. As I started out saying, this is a major and challenging issue of our time. I have applied a measure of personal exertion in this submission in the hope it will be receive by you with reciprocating interest, as you read and be roused. I have tried my utmost to stay within the terms of reference without glossing over the modulations of water damaged buildings on biotoxin illness and the much bigger picture. I wish you the best in your inquiry, and would be happy to be contacted if necessary.

Tim Law, PhD Architectural Scientist ARCHSCIENCES www.archsciences.com.au

Significant news stories about mould impact

25 October, 2018
"When your home poisons you: Investigating mould-related illnesses" - ABC News
https://www.abc.net.au/news/2018-10-25/mould-in-homes-causing-sickness-investigated-by-inquiry/10423818

10 November, 2018
"Mould avoiders: The Aussies going to extreme lengths to treat chronic illness"
https://www.9news.com.au/national/mould-avoiders-the-aussies-going-to-extreme-lengths-to-treat-chronic-illness/da87a05d-b66b-4be8-b93f-8f8737ec8622
*shifting into high ventilated living spaces was the solution.

9 August, 2019
"Townsville flood aftermath: Resident's relentless mould battle six months after monsoon event" – ABC News
https://www.abc.net.au/news/2019-08-09/health-impacts-of-townsville-floods-mould/11390952
The Townsville house in the story was effectively rebuilt after the floods. If bulk insulation had been used in the walls of the flooded home, it would have taken longer for the home to dry out compared if it were not used, compared to if say a foil wrap alone was used.

29 November, 2017 (UK)
"Residents' fight against cavity wall insulation issues" – BBC News
https://www.bbc.com/news/uk-wales-42165358

18 April, 2017 (UK)
"Cavity wall insulation 'a scandal', Arfon MP claims" – BBC News
https://www.bbc.com/news/uk-wales-politics-39602540

30 September, 2016 (UK)
"Call for Wales-wide cavity wall survey" – BBC News
https://www.bbc.com/news/uk-wales-37517568

28 August, 2015 (UK)
"Damp in social housing" – BBC News
https://www.bbc.com/news/uk-wales-politics-34081718

COMMENT on UK News items

Two likely reasons for interstitial moisture in the cavity due to:

1. The cavity being breached by bulk infill insulation, then wicking any external moisture through the bulk into internal wall surfaces – and can't dry out, causing mould
2. The temperature gradient of the wall has been altered because of the insertion of the bulk insulation (when no risk existed before with a defined air cavity), and the Dew Point then triggered somewhere within the matrix of the bulk insulation.

GENERAL COMMENTS

1. How can the ABCB possibly justify its policy of increasingly energy tight housing coupled with high insulation levels, when it appears that this combination is seeing rises in condensation and consequent mould?

2. Why has there been no 'further research' into causes of mould, in the Australian context, which was specifically called for in the recommendations of the 2016 ABCB Condensation Scoping Study, and strongly reiterated by Dr Tim Law in his Submission 75 to the Parliamentary Inquiry?

3. There is increasing evidence of condensation and mould formation in residential buildings, and consequent health risks such as CIRS, running parallel with increasing building air tightness and steadily rising residential insulation levels in the NCC from 2004-2016, in particular the shift from 5 Star (2006) to 6 Star (2010).

4. The Australian news stories here (and possibly supported by UK news stories), prompt a fairly obvious and compelling question: should bulk fibrous insulations be avoided within houses in any damp or hot-humid climates - in walls, ceilings or floors? The possible answer is YES. Yet again, further justification for a national investigative research program, which must be independently run this time, and not relying primarily on house data provided by CSR Building Products and BRANZ.

5. Where is the evidence that 'breather membranes' physically breathe? After contacting BRANZ in August 2019 (noting that CSR Building Products were consultants to the Scoping Study 2016), BRANZ confirmed that 'BRANZ Appraisals' are the ownership of the client and advice was given to contact CSR directly. Contact was made with CSR and no documentation has been released as yet. Accordingly, what right has the ABCB to compel the use of breather membranes in walls of residential buildings in NCC Climate Zones 6,7,8 when such products have not been ascertained to be 'fit for purpose' to eliminate or reduce formation of condensation?

The answer to Question 5 requires actual house testing in 'Dynamic State' with varying levels and differing types of thermal insulation, and study the interaction between energy efficiency and vapour movement. The continuation of relying on 'Steady State' testing of building elements and structures retards any possibility of resolving monumentally important issues.

The ABCB to date has made no announcement to endorse further research as directed by the Parliamentary Biotoxin Inquiry report. Computer programs and modelling do not fit the definition of 'further research'.

2018 (November 11) – Submission to Standards Australia Committee BD-058
Joint Authors: Dr T.Harkness & Dr. R.Aynsley
https://www.afica.org.au/pdf/Harkness%20&%20Aynsley%20Submission%20on%20AS%20NZS%204859.1%20&%202%20-%2012Nov2018.pdf

This submission was initiated by Dr Harkness after Tim Renouf alerted him about what was about to happen with the imminent printing of the revised standard AS/NZS 4859.1 & 4859.2 on 19 November.

Dr Harkness was supported by Dr Aynsley, and the submission challenged the official publication of twin insulation standards (see next topic item), which was a major revision of the first insulation standard dated 2002. The new twin structured standards, split into two parts, perpetuates the use of the unitary 'mean' temperature 23degC testing of bulk insulation, for use anywhere in Australia, while allowing radiation effects to be adjusted mathematically, on a basis with no explanation as to when and how they ought to apply.

The Harkness-Aynsley submission was attempting to heavily question the use of 23degC as being inadequate when considering in-situ roof radiation impacts upon houses in hot climates temperatures, as typically found across virtually all of Australia. The late submission of course could not stop the power of Standards Australia.

Some opening quotations

We respectfully suggest that the proposed AS/NZS 4859.1 and AS/NZS 4859.2 be subjected to a scientific review before publication or adoption for the NCC 2019.
Examples only of matters for review in AS/NZS 4859.2 include:
Typographical errors: For example in 8 Air Films Line 1 of (a): "surface son" should read "surface on";
in Table 13, should d - 0.44 read d - 0.44 ?
Definition of terms For the lay reader: Define Ug and Ux
XPS could be defined as expanded polystyrene and PU as polyurethane.
In 5.2, To is defined as mean operating temperature as given in Eq 9.3(4) however, Eq 9.3(4) shows Cave, not To.
This is unnecessary fog and shows lack of care. Maybe different sections of the Standard were cut and pasted from different sources. Consistency in the definition of symbols is necessary.
The only persons who should be allowed to vote on the adoption of these Standards are those who sit for and pass an examination on their contents.
AS/NZS 4859.2 ignores solar radiation in 5.1 "Standard Assumptions" of temperature and temperature difference through the building envelope. The significance of this omission is described in the attachments.
Excluding the effect of solar radiation on the exterior surfaces of the building envelope from calculations could lead to inability of installed insulation to enable a cooling system to provide thermal comfort; and lead to higher energy consumption than estimated.

2018 (December) – Publication of revised insulation standard
AS/NZS 4859.1(2018) – Thermal insulation materials for buildings - General criteria & technical provisions
AS/NZS 4859.2(2018) – Thermal insulation materials for buildings - Design
https://infostore.saiglobal.com/en-au/Standards/AS-NZS-4859-1-2018-116009_SAIG_AS_AS_2685445/
Produced by: Standards Committee BD-58
*the dual standards are not free and have to be purchased and have COPYRIGHT restrictions, which makes open public discussion very difficult.

The previous insulation standard was radically restructured and split into two documents, so that determining Total R-values for insulations in-situ could be more simply found in Part 2.

In the final Public Comment phase, Standards Committee BD58 rejected a technical complaint submission by Tim Renouf, who described the failure of continuing with official labelling of bulk insulations at the static (or Steady State) 'mean' temperature of 23degC, and that it was against the public interest to have optional variation measurement at different temperatures, because nobody would do it.

This is grossly misleading in some design situations such as bulk insulations under hot roofs (see 2001 AGO doc. – 40% reductions in R-value) and around roof space cooling ductwork which carries refrigerated air. The second standard 4859.2 is incomprehensible to virtually every reader and made worse because there are zero explanatory notes, which leads to only one conclusion, in the opinion of this writer, that the document was intended not to be understood, and thereby completely 'captured' by vested interests.

The overall issue spanning about 20 years, is that Committee BD58 has steadfastly refused to even permit discussion about 'Dynamic State' thermal testing, and holds on to the international 'Steady State' methodology without consideration of other views.

It is the contention of the writer and that of AFICA, that Dynamic State testing is the primary approach in the understanding and resolution of vapour movement and condensation risks. It would appear also to have been scientifically logical to have merged thermal and condensation issues into the major revision of AS/NZS 4859.1 (2002) in addition to a complimentary stand alone Condensation standard that is planned for the progression of steps to lessen condensation risk and mould in buildings.

However, the facts stand that Committee BD-58 has a perpetual fortress like mentality and structure, its ramparts can never be breached after decades of skilled practice, and they have never been interested in an open transparent discussion of building thermal performance, for the sake of the public and national interest. And the reason? Because Industry writes Standards, and everybody knows that, and the iron clad 'Committee-In-Confidence' club rules protects the fortress, and SA maintains this stance in defiance of the SA Technical Governance Review 2018 recommendations (see earlier) to substantially open public participation on standards and make all documents publicly available at any time.

Of course, what trips up Standards Australia, which they cannot escape, is that the joint MOU Memorandum of Understanding with Government is overarched by the fact that all standards are premised on demonstrated overall 'Public Net Benefit'. Somehow, Standards present their website and image to give the impression that the public comes first, which in the case of the suite of building energy efficiency standards, is not true. The sister insulation installation standard AS 3999 (2015) also has a list of faults and omissions.

Amplifying problems with the insulation standards, is that the ACCC have stated in correspondence that building energy efficiency performance claims are not within their jurisdiction, which is patently false – see Timeline 2005(February) and 2006(October) meetings chaired by AGO, where the ACCC are clearly involved.

The end result is that the public are stranded in ignorance about what constitutes the most appropriate insulations for the respective climate, made worse because there is no independent technical advice bureau to turn to, and the public are left to navigate through private companies pushing their own commercial agendas "to make a sale", words revealed in evidence given to the 2014 NEEBP report into house energy ratings (see earlier Timeline entry).

The condensation problems occurring since 2004 adds 'fuel to the fire' of the lack of evidence-based standards and regulations.

2019 – AIRAH "Managing Summer Cooling Loads in Code-Compliant Australian Housing"
https://www.airah.org.au/Content_Files/Special-Technical-Groups/2018_Summer_Loads_Ventilative_Cooling_Technologies.pdf?pdf=Summer-Loads
Author: AIRAH Special Technical Groups

In 'Foreword: The Problem', reference is made to the 2013 report "The evaluation of 5-star Energy Efficiency Standard for residential buildings" in which they studied 414 houses in Brisbane, Adelaide and Melbourne (See Timeline discussion). Winter heating predicted had good alignment with actual outcomes, but for cooling the houses used higher than expected cooling energy – 31% in Brisbane and 38% in Melbourne.

In the aim of the report (pg 15), was to recommend vigorous mechanical purging of houses in hot climates, while it refused to consider reducing the thermal envelope with less insulation (and other issues). Additionally, the AIRAH committee did not consider, or want to consider, that there may well be a direct correlation in hot climates for houses to have higher cooling demand due to high bulk insulation R-value levels, and whether a simple option might be to lowering the amount of insulation, and to use reflective insulations.

Nowhere in the report is aluminium foil mentioned, nor a discussion between 'resistive' (bulk) and 'reflective' insulations (foil). For Brisbane housing, a dominant summer cooling location with no winter heating, the AIRAH report should have acknowledged the unique thermal properties of reflective insulations of differential UP and DOWN R-values, whereby foil stops downward radiation, and facilitates rapid night time cooling with lower resistance to heat flow up. A feature that bulk insulations fundamentally does not have. A subject presented to regulators by Richard Aynsley in 2000 and earlier first identified in Australia with the 1981 AHRC Qld study (see Timeline references).

All through this Timeline, look for patterns. Regulations which continuously promote high levels of bulk insulation, and do not discuss, promote or advocate the special applicability of reflective foil insulations.

2019 (January 16) ABC TV 7.30 program – *"Extreme Heat Felt Across Australia"*
https://www.abc.net.au/7.30/extreme-heat-felt-across-australia/10721126
The program segment comprises a series of Adelaide interviews.

ABC Introduction: *"Its been a scorching week. The extreme heat is being felt across Victoria and NSW, with record temperatures in parts of South Australia close to 50 degrees.*
The Bureau of Meteorology has warned the future will likely be even hotter. And that has prompted calls for stricter construction standards to make homes more heat resistant."

Landscape gardeners filmed in the heat and stating that they are able to work for only half the day, and (at end of 7.30 segment) saying *'we might start being night time landscapers'*.
Adelaide nursing home handing out ice blocks to residents.
Prof Paddy Phillips, SA Chief Public Health Officer: *"What we know is that heat is the worst of our natural emergencies, with excess hospital presentations, ambulance transfers and people even potentially dying, and we want to prevent that."*
Peta Marshall: *"Is not prepared for the onslaught. Despite her Housing Commission property being brand new, it's a sweat box in summer. The house has been poorly designed to resist heat.*
It seems like there wasn't enough thought put into the house because the house gets full sun and there's no heating and cooling, so it makes it really difficult to survive."
Mark Henley – Welfare Advocate:
"We're absolutely convinced that the quality of Australian housing from an energy efficiency point of view is going backwards compared to where we were 50 or more years ago.
The reality is we have very poor rental housing stock in Australia."
ABC: *"And without solar panels, constant cooling can lead to sky high electricity bills"*
Prof John Boland – Univ SA: "*Home owners are paying for poor quality design in the long term, because they need to operate their air conditioners more in summertime than if the house was designed properly in the first place."*
ABC: *"University researcher Prof John Boland says not enough is being done to future-proof Australian homes against rising temperature. He says the national building code needs reform to put more emphasis on how well homes cope in the heat"*
John Boland: *"So what happens if you try to get a 6 Star rating? Most of it is based on winter use . So you can have a very energy efficient house overall under the rating scheme, but it will still be heat stressed in summertime."*
ABC: "*The Australian Building Codes Board told 7.30 it will be improving the standards by May"*

COMMENT
The federal NCC residential energy regulations and reference insulation standards do not account for high level radiant loads on residential buildings, and additionally the impact on operating costs of cooling systems.

2019 (February) – NCC May 2019 changes *vapour permeability, energy efficiency & fire requirements

Vapour permeability
https://www.abcb.gov.au/Connect/Articles/2019/05/21/New-condensation-requirements-in-NCC-2019
Key change: Walls in Climate Zones 6,7,8 using pliable membranes must be 'vapour permeable'.

In February 2019, technical bulletins from CSR Bradford appeared, describing impending changes to the May 2019 edition. The impact upon the foil insulation industry was severe and came without any forewarning.

As a result of earlier condensation reporting (e.g. Aynsley 2012) and the ABCB Scoping Study 2016, foil insulations were singled out for blame regarding condensation in residential wall construction, with the near

total replacement of any wall foils with 'breather membranes'. This automatically meant no foil wrap membranes to be used. (NB: A concession was finally given to BV walls being able to use 'breather' vapour pin-pricked foil).

What the ABCB and NCC conveniently omitted to explain in the changes, was that the 2016 Condensation Scoping Study, had additionally recommended that further research in the Australian context be undertaken. There has been complete silence about this from the ABCB, except they have said the "ABCB is not obliged to adopt the Scoping Study report findings". That sounds like 'cherry-picking' - ban foil in walls for condensation risk reasons, without doing further Australian research, and thereby totally ignore the unique thermal benefits of foil membranes protecting Australian houses from incoming solar radiation, which is set to increase over coming decades.

Furthermore, there was no scientific proof provided that the imported breather membranes actually facilitated the free passage of vapour laden air migrating through the matrix of bulk fibrous insulation materials. There is no known formal Appraisal There was also a lack of explanation regarding the contradiction with breathing walls regulation changes. Styrene wall board insulation mounted on framing, in addition to rendered styrene (which gives a concrete-look finish), are both identical to wrapping houses in plastic - the complete impossibility of breathing! Using breather membranes wall wraps would be pointless. The ABCB has said nothing about this contradiction, and nor was there any mention of this in the Condensation Scoping Study

The NCC 2019 breather changes had no full Industry consultation, nor forewarning. Active participants in the NCC changes were CSR Bradford, BRANZ, Institute of Architects, and Building Surveyors; the rest of the Industry knew nothing. After an industry backlash, a reprieve was given in March for the use of breather perforated (pin-pricked) foil wraps in brick veneer walls, as what had existed on the market for decades. It is the opinion of the writer that an adjustment to the perforating procedure be undertaken to enhance the breathing function, a perfectly simple adjustment.

The situation was made worse because the conventional NCC transition period of 12 months for industry to adjust, did not happen. The 12 months applied to other NCC changes (new insulation standards & fire requirements), but not to the breather membrane changes. The ABCB refused to explain this inconsistency.

The second attack against the foil industry occurred in February 2019 with publications from the fibreglass insulation companies strongly recommending breather membranes in all residential roofs in all 8 Climate Zones. This effectively meant that the established use of reflective foil sarking membranes in Australia, commencing in 1952, was under deliberate and sustained assault aiming for its complete decimation.

Energy Efficiency & new fire requirements

In addition to the vapour permeability changes to the 2019 NCC, there are two other changes which impact on insulation materials; the adoption of the newly revised insulation standards AS/NZS 4859.1(2018) & 4859.2(2018), and more stringent fire testing for insulation materials thicker than 1mm (stemming from the Grenfell UK fire and Australian cladding crisis). These two NCC changes have a 12 month phase in period.

2019 (February-March) - Formation of second aluminium foil insulation association AFICA Inc.

The sudden 2019 NCC condensation changes were the primary trigger to form AFICA, in order to fight for the survival of the aluminium foil insulation industry.

The pre-existing foil association AFIA (of which the writer was a foundation member 1996-2019) had a steadily diminishing membership since 2000, and was still relatively united until the publication of the significant findings (6-11) of the 2010 Senate Inquiry – HIP. That Inquiry's findings were very well crystalised in the final

Recommendation 11 (in part here): *That the government form a small advisory group, representative of all of the different components*

Since 2010 the AFIA leadership did not comment on or discuss the merits of pursuing the Senate Inquiry or any other pro-foil insulation report as they occurred, nor any reports dating from 1952. The full significance of the foil reports can be seen through the lens of the accelerating call in building codes for *climate adaptation strategies* to counter rising temperatures, where 50degC days are predicted to become more common in parts of Australia. Aluminium foil was a substantial climate solution, yet AFIA made no special media releases about the impact of impending higher temperatures.

During 2017-2019 the full AFIA membership were not fully informed about pivotal issues unfolding in the revisions of the suite of insulation standards, so much so that the writer took matters into his own hands and distributed any BD-58 'Committee-in-Confidence' documents that came his way, to the small AFIA membership. He did so because the April 2018 'Governance Review' into Standards Australia had recommended sweeping changes to allow public access to the work of Committees, but SA have not adopted this policy even though they said they would in April 2018.

The final straw broke for the writer when in February 2019, AFIA had had inadequate discussion time to handle the dramatic impending foil wrap changes coming into the NCC May 2019, as did most of the entire insulation industry. Accordingly, Tim Renouf resigned from AFIA and, with tremendous assistance, immediately formed AFICA to defend aluminium foil insulations, their manufacture as well as promotion.

2019 (July 25) – News - *Europe Heatwave: Why are temperatures soaring on the continent?*
https://www.bbc.com/news/world-europe-48756480

2019 (July 25) – News - *A Heat Wave Bakes Europe, Where Air-Conditioning Is Scarce*
https://www.nytimes.com/2019/07/25/world/europe/heatwave-record-temperatures.html

LONDON — Never in recorded history has Paris been hotter than it was on Thursday, when the temperature neared 110 degrees. The same was true of Belgium, Germany and the Netherlands, as a dangerous heat wave scorched Western Europe.

"Air-conditioners are expensive and consume a lot of energy," Sadio Konte, a 26-year-old cooling himself in the waters of the Trocadéro, by the Eiffel Tower, said Thursday. "Making the most of fresh and natural places is a smarter solution. And it's free."

COMMENT

There are endless news items over the past 20 years, related to the increasing frequency of record summer heat temperatures in the northern hemisphere, as well as Australia.
And what are the best performing insulation materials to address high intensity radiation?
Aluminium reflective foils. Houses full of bulk insulations and high thermal mass eventually become overwhelmed by high intensity radiation, sometimes quickly, sometimes slowly, and are slow to release the 'stored heat'
Why? Because bulk insulations are not tested for high temperature – the root of the problem.

2019 (July) – ABCB "Energy efficiency: NCC 2022 and beyond – Scoping Study"
https://consultation.abcb.gov.au/engagement/energy-efficiency-scoping-study-2019/user_uploads/scoping-study-energy-efficiency-ncc-2022-and-beyond.pdf
Public submissions close September 8, 2019.

Submissions to this Study are intended to influence the final outcomes for the NCC 2022 and beyond, however '*this Scoping Study does not constitute a decision to change the NCC, but rather a commitment to undertake a thorough process to determine if changes to the NCC are warranted, and if so, to what extent.'*
The document is once again very hard to understand, making it difficult for serious public engagement.

Two options being considered for residential housing pg 1-2

a) a level of thermal comfort equivalent to 7 Stars NatHERS and net zero annual energy use for the regulated building services, i.e. space conditioning, heated water systems, lighting and pool and spa pumps.
b) a level of thermal comfort equivalent to 7 Stars NatHERS and a moderate amount of annual energy use for regulated services.

The two options will enable a 'whole-of-house' approach to be used to achieve compliance. In particular, compliance through Verification Methods (or whole-of-house tools) will allow some trading between the energy efficiency of building services, and allow limited offsetting with on-site renewable energy……

In developing the proposed changes to NCC 2022, the ABCB will also undertake a holistic review of the residential energy efficiency provisions. This will include consideration of related issues, such as condensation and heat and cold stress…and take account of regional differences.

Regulation impact analysis will be undertaken to ensure all potential changes to the NCC are underpinned by rigorously tested rationale, are effective and proportional to the issue and generate a net societal benefit.

Pg 9
….the NCC 2019 include…..a new sealing Verification Method, based on blower door testing has been added…..Separate heating and cooling load limits now apply in addition to the specified star rating under the NatHERS compliance pathway to help ensure buildings are more comfortable year-round….

Pg 33
3.4.1 Use of future climate weather files
This proposal would involve an investigation into changing the energy modelling requirements…and to use weather files based on future climate scenarios…. "Current industry standard weather files for building simulation are not suited to the assessment of the potential impacts of a changing climate, in particular summer overheating risks"

Pg 35
3.4.2.1 Extending the requirements around the calculation of thermal bridging
…calculating Total R-value (AS/NZS 4859.2)….

Pg 42
4 Consultation
Meaningful consultation promotes trust between industry, the community and government. Transparency allows stakeholders to see and judge the quality of government actions and regulatory decisions…..

COMMENT
What does *meaningful consultation* or *trust* mean, when balancing the public interest with business interests? Or does it actually mean letting business call the shots through the maze of technical report jargon, and regular consultants, and then window dress the final decisions for public consumption, i.e. *"its all so technical, I can't understand it, so it must be right, and individual comments will be ignored anyhow".*

Trust is in rather short supply when it comes to the Australian building industry and its regulations over the past few 20 or so years.

To say the NCC regulatory process, under the COAG framework, considers the public interest ahead of business interest is patently false.

The 'holistic review' above has summarised fairly well the interconnecting physics. The reader can wonder what precisely does 'holistic' mean. Does it mean: total house testing, Dynamic State versus Steady State measurement and continue on sealing up houses across Australia? And do we just default to 'computer modelling programs', which magically solve all human decision making, without hard back up data?

What about heat and cold stress testing of buildings? What about the extensive reports in the Timeline e.g. 2013 NCCARF report 'Adaptation of Australian households to heatwaves', and the need for heat stress resilient buildings, and the persistent recommendations for reducing radiant heat energy loads by using reflective foil insulations and reflective roofs?

The 2022 Study does not mention the word radiation. Not once. Even when the words above are read….*in particular summer overheating risks.*

Sealing up houses in many situations is plainly stupid and goes against common sense on health (Timeline 2018 Biotoxin Parliamentary Inquiry) as well as energy efficiency grounds, when natural ventilation is widespread across Australia and healthier and the cheapest way to cut power demand for cooling, which many school children probably know is true.

The 2016 ABCB 'Condensation Scoping Study' (See Timeline 2016) made a primary finding that condensation was occurring in housing since 2004, which paralleled with steadily rising amounts of bulk fibrous insulation and increasing air tightness of buildings. Now the 2022 Scoping Study is saying (like the bus is going over the cliff) let's keep tightening the building and jack up the Star rating to 7 Star, because breather membranes will save the day. Will they? Breather membranes fundamentally cannot repel incoming high intensity solar radiation, when reflective foil insulations most certainly do.

And what about considering the novel (and obvious) idea of reducing the bulk fibrous insulation levels, based on the valid Law of Diminishing Returns, also known as Diminishing Benefit? (see Timeline 1981 & 1991). The 2016 and 2022 ABCB Scoping Studies did not even offer this as a forward-looking option – and why might that be? Because powerful business interests (i.e. bulk fibrous insulation industry) determine government policy, through opaque or difficult to understand scientifically unsound technical briefing papers, by not accounting for realistic solar radiation levels and time duration.

The 2016 Scoping Study, Stage 1, concluded that for the NCC May 2019, vapour permeable membranes were to be made mandatory in walls for Climate Zones 6,7,8 without widespread industry consultation nor any Australian physical testing or scientific appraisal certificates required (e.g. BRANZ), and where product performance was based solely on existing ASTM-USA test documentation, even though the 2016 Study stated that physical testing research in the Australian context was required before any regulatory decision was made.

The primary consultants to the Study were CSR Building Products and BRANZ. No independent foil insulation companies were ever consulted, and the people who had condensation issues examined in the Study were 'hung out to dry' with no technical assistance to rectify their issues, which could have been incorporated in the Study to establish what were the best materials to address the condensation issues.

It appears that the 2016 Study had a bet each way, removing reflective insulations for walls, and mandating an unproven product (vapour permeable breather membranes) for Australian winter climatic conditions, and remove the use of reflective insulations with no conventional 12 months transition phase, while simultaneously declaring that further research was needed. Rather like the cart before the horse, or better

still saying commercial business interests come ahead of 'fit-for-purpose' Australian testing. Who is running government policies, private or public interests?

Now we are facing some big changes to the NCC 2022 (also known as Stage 2), knowing that no further research conducted, but what evidence is there that the government will be amenable to investing in national thermal-condensation research? It doesn't look promising after what happened or didn't happen in 2016, i.e. no testing was immediately instituted.

In light of the potential of a changing climate, where 50degC is predicted to impact more frequently in Sydney and Melbourne, the reader might have thought by now that physical house testing was obvious and unavoidable, instead of relying on never-ending flawed computer modelling adjustments (occupant behaviour), that are not soundly based – **a pattern** running through all past ABCB studies and it's well known consultants. To be fair, the occasional report produces blunt and accurate advice, and then we have data provided from 'house research facilities' owned by large building products companies (i.e. CSR) which is a conflict of commercial interest against the public interest, because it is not independently funded research.

What is needed is independently operated building research testing facilities in Australia, to guide government policy making, in the public and national interest.

2019 (July) ABCB – NCC – "Condensation in Buildings" - 3rd Edition
https://www.abcb.gov.au/Resources/Publications/Education-Training/Condensation-in-Buildings
A highly detailed manual incorporating breather membrane changes to NCC May1, 2019.

However, if people do not read it, they are not informed about the complexity of the issues. Most will not read the Handbook, and when it comes to a practical application, there will be complete confusion between all the parties because of one thing – time and profit. In other words, the builder or designer mostly will not care, and will make decisions on past experience.

2019 (August) – News – *Hayne takes swipe at MPs' 'language of war'*
https://www.afica.org.au/pdf/News%20-%20The%20Australian%20-%20Kenneth%20Hayne%20takes%20swipe%20at%20MPs%20(trust%20in%20institutions%20has%20been%20damaged%20or%20destroyed)%20-%208%20August,%202019.pdf

Former Royal Commissioner Kenneth Hayne was reported in 8 August, 2019, as giving a speech to Melbourne University's 2019 Constitutional Law Conference in July. This news story is highly relevant to the purposes of this Timeline.

Extracts:
'Mr Hayne said trust in all sorts of institutions, governmental and private, has been "damaged or destroyed" and painted a picture where the meticulous work of royal commissions contrasted greatly with the political process……"and it would be necessary to reveal more about what the lobbyists and interest groups are telling government," Mr Hayne said.'

COMMENT
It's difficult to know what to add to what Mr Hayne said. Although as good as these words may sound, Mr Hayne exposed some of the problems, but there was no directive for fixing the issues.

In Australia that most powerful voices of the building insulation industry heavily influence government energy efficiency regulations, as this Timeline has revealed. No member of the public has any realistic hope of influencing the NCC regulations, which are mandatory and literally impossible to unravel or decipher.

TIMELINE CONCLUDING COMMENTS

A common theme keeps on repeating through this Timeline, the HERS energy ratings and the associated insulation standards are not reliable; as the star ratings rise there is no correlation in reducing energy use. More HERS 'real house' research was called for during the period 2000-2010, by determined academics such as Dr Terry Williamson (Univ Adelaide) and Dr Richard Aynsley, who have been largely ignored.

Whenever the power of vested interests is seriously challenged in correspondences sent to relevant authorities by qualified academics or diligent members of the public, they are all systematically ignored or written reply letters and emails saying that they *"are grateful for the issues you have raised in your correspondence, and such issues are able to be addressed through representative stakeholders bodies"* that sit on relevant committees connected to legislation. Identical type responses are manufactured on a near industrial scale of repetition from politicians to constituents, with little exception.

Put simply, the government is 'captured' by vested commercial interests and refuse to instruct a new thermal testing approach and just leave everything in the hands of Standards Australia, who have unbalanced committees where the public interest is not correctly represented.

In relation of building energy efficiency policies, what actually has happened is that 'regular' well known consultants were engaged repeatedly over years to write technical reports (and still do) to meet the perpetual demand which underpin ABCB Regulatory Impact Analysis (RIA) and Statements (RIS) and other consultancies, which ultimately justify the introduction of policies, such as house energy ratings 5 Star (2006) and 6 Star (2010). The same names appear over and over again.

Most of these advisory reports are incomprehensible, not evidence-based and 'not in the real world'. Then the reports are invariably accepted, and the new NCC regulations compel the installation of higher levels of bulk insulation, and the entire process appears unstoppable even in the face of repeated conflicting warnings written in a variety government funded advisory reports, as listed through this Timeline.

The occasional report will directly challenge what the ABCB wants, and be ignored – see CIE "RIS" further on. The CIE were extremely brave in 2009 when they warned against the adoption of 6 Star HERS house ratings.

Over and over again, further research has been pleaded for. The Timeline here provides an extensive list. The overarching theme is the call for actual house testing using relevant climatic conditions, be that cold, mild or hot climates, coupled with analysing local Australian construction techniques, and not relying solely on computer modelling and construction methods from overseas.

But no, the regulations just leave the answers to be found in the insulation standards, purposefully indecipherable complex standards written by Industry, and the standards keep failing, because they are not 'evidence-based' and are not providing 'demonstrated Public Net Benefit', a central tenet of all Standards. The insulation standards, in particular AS/NZS 4859.2–2018(Total R-value computations) and AS 3999–2015 (installation), are scientifically unreliable and mislead the public and cannot be understood because, fundamentally, they are not 'evidence-based', they are not based on 'real world' installed performance.

Condensation & vapour movement

The NCC 2019 condensation changes must be challenged with open public discussion about the consequences for energy efficiency of residential buildings, and what will happen if reflective insulations disappeared from Australian building design.

There were no issues regarding condensation and mould in Australian buildings from 1952 – 2004, where foil insulations were used extensively in a wide range of buildings, residential, commercial and industrial. In this period, bulk insulation used in ceilings of residential buildings was invariably restricted to being an R2-2.5 level, namely just to the tops of ceiling joists, an R value level recommended by CSIRO for decades.

Condensation and mould became evident in the period 2004-2016, exactly at the same time period when regulatory insulation levels substantially increased, coupled with increasing air tightness of housing. This correlation was likely first reported by Dr Richard Aynsley 2012 (refer his AIRAH journal reports in Timeline), and then confirmed in two research reports by Dr Tim Law & Dr Mark Drewsbury (Univ Tasmania) in February 2016 for Tasmanian government, and nationally for the ABCB in September 2016 (i.e. Condensation Scoping Study).

Advice from Dr Richard Aynsley

From 1998 to the present day, Dr Richard Aynsley (former Head of Tropical Architecture, James Cook Univ.) has been advising and warning key agencies such as the ABCB, Standards Australia, Productivity Commission and Senate Inquiries about what is wrong with residential building energy efficiency codes and standards, and the early condensation warning advice to the ABCB 2011-12 (all listed through the Timeline).

It was very early on in 2000, that Aynsley made the first statement regarding foil in the tropics, followed by his 2005 (Feb) report on foil in roofs.

2000 - Unique Advantages of Reflective Airspaces & Energy Efficiency in Australian houses -
Why Reflective Insulation Should be Used in Warm Coastal Regions:
Horizontal reflective air spaces are the only type of insulation which offers:

- *A high resistance to heat flow downward through the roof from solar heat gain*
- *A low resistance to heat flow upward through the roof allowing rapid heat loss in the evening*
- *No other insulation material has these properties."*

2016 (in relation to condensation and thermal performance in housing).

"We have a long way to catch up due to:

1. *Our decline in the quality of **Australian Standards** relating to building construction and building materials.*
2. *Our lack of reliable **data on local climate and properties of Australian building products** needed for sophisticated software such as WUFI.*
3. *Our lack of a **reliable theory on water vapour transmission** through building construction.*
4. *Our lack of capacity for **field validation of moisture issues** in housing in Australia's wide ranging climates.*
5. *Our current **doctrine of sealing houses** to achieve energy efficiency without consideration of adequate ventilation for controlling mould growth"*

Additionally, it is highly relevant to point out that both 5 Star (in 2006) and 6 Star (in 2010) house energy rating levels have not been justified for end benefit to the consumer. The rejection of 6 Star levels was made by consultants CIE in two reports, for the MBA Master Builders in 2010 and earlier in 2009, being the official commissioned consultants to the ABCB's 'Final Regulatory Impact Statement' for 6 Star (refer Timeline).

By introducing greater building vapour permeability with breather membranes in walls, the NCC 2019 has taken the approach of maintaining high insulation levels under 6 Star HERS, and reflective foil insulations have been targeted for causing condensation. The 2016 Condensation Scoping Study research report gave 'first phase' NCC advice to adopt 'breather membranes' in residential walls, but also to undertake further research regarding condensation, before any regulatory solutions or strategies were adopted. This did not happen.

Historic condensation reduction advice has always been to position vapour barriers on the warm side of any building assembly, i.e. in winter behind internal wall linings, but instead the 'breather membranes' are being claimed to be capable of allowing moisture vapour to be actively driven through bulk insulations to be discharged and dissipated outwards. The writer has seen no hard evidence that such products actually do this.

An obvious alternate strategy to the NCC changes would have been to reverse the insulation levels back to the levels justified by CSIRO (in 1981 & 1991) and halt the policy of increasing air tightness of building fabric envelopes, i.e. the space defined for heating or cooling. Having an air tight building in dominant hot climates, roughly 50% of Australia, is plainly ridiculous for the majority of the population and is extremely energy inefficient.

Building designers in Townsville Queensland, have stated in the 2014 NEEBP report (see Timeline) that house design for the tropics, in ceilings, using double layers of foil in ceilings works better than bulk insulation. However, this significant and startling comment came after the decision to implement 6 Star in 2010. In other words, 'after the horse had bolted'. But earlier warnings pre-2010 about the problems of bulk insulations in hot climates were known.

It seems astounding that from all the reports, publications and warnings given over 20-30 years, that the federal and state governments have not commissioned independent testing of housing covering the interaction of thermal efficiency and risk of condensation.

The juggernaut of blaming roll form foil insulations anywhere in dwellings for causing condensation has to end. There never was a problem up until 2004.

Furthermore, the proliferation of downlights has played havoc with building energy efficiency requirements, whereby regulatory fire clearances became an invitation for house heat to escape into roof cavities exacerbating condensation risks against any cold surfaces, while simultaneously destroying claimed winter R-value performance of bulk insulations enforced in the NCC energy efficiency regulations. From 1998 to 2019, these issues and more, have been completely ignored by Standards Committee BD-58 and the ABCB (who reside on BD-58), issues needing thorough examination in the Australian context to address the myriad of conflicting in-situ insulation issues.

Aluminium Foil Insulation Council of Australia Inc. (2019)

It is now the task of the new foil insulation group AFICA to promote the unique thermal benefits of aluminium foil insulations, and to reactivate the case for mandatory control measures for reducing radiation entry into all residential buildings, using demonstrated technologies based on 'real world' installed insulation performance under uniform 'level playing field' temperature conditions for all insulation materials, as opposed to the traditional static laboratory testing method used for bulk insulations.

The proven benefits of reflecting radiant heat under residential roofs across Australia is well known to the ABCB, as reported in the August 2018 report of the Senate Inquiry – Impacts of Climate Change on Housing (see earlier). What is needed now, as it was 20 years ago, is to undertake 'real house' testing of insulation systems, by a completely new independent research team, as opposed to continuous dependence on upgrading NatHERS computer modelling, when NatHERS is not validated by Australian house testing representative of the wide variety of differing climates and building construction.

The splitting of NatHERS into summer and winter cooling loads, announced but unexplained in the NCC 2019 changes, will be inadequate to meet 'heat stress resilience' requirements to be factored into the NCC 2022.
The new foil association AFICA is the only body capable of defending foil insulations, and guiding foil usage, which includes re-educating tertiary academic institutions about the 'lost history' of reflective insulations.

News reports during 2018, stated that by 2030, 50degC days will become frequent for both Sydney and Melbourne. This has been highlighted earlier in the 2013 Univ SA research. Regulators and Standards avoid discussion of actual realistic radiation impacts upon buildings.

This highlights the need for climate adaptation strategies to counter rising heat levels, for reducing cooling running costs, as well as human survival in the event of mechanical failure in cooling appliances, or the failure of the power grid when power shedding occurs.

Why does the ABCB rely on the same consultants over and over again and expect to get different or better results, without undertaking a nationwide Australian house testing program, at arms length from large private building products companies?

"The definition of insanity is doing the same thing over and over again and expecting a different result"
(Attribution to Albert Einstein)

Summation

1. Standards Committee BD-58 editorial control is held by ICANZ, the fibreglass insulation industry, and ICANZ declares openly to promote bulk insulation and not foil insulations.

2. Standards Committee BD-58 and the ABCB rejected the unique opportunity provided in 2013, when it abruptly abandoned the case for mandatory foil insulation for residential roofing as radiant heat shields (see earlier). This Timeline illustrates the overwhelming case for reflective foil insulations.

3. Technical findings of the '2010 Senate Inquiry – HIP Home Insulation Program' for an independent review of the insulation industry and standards, has been totally ignored in the evolution of the revising any of the insulation standards.

4. The findings from the 2014 Royal Commission HIP revealed electrical cabling installation to be at fault with massive breaches of the Wiring Rules for decades, compounded by zero safety inspections by all state Electrical Safety Offices (ESOs). And foil insulation was unfairly blamed. The electrical industry have remained completely silent about their own industry's severe failings with no national warnings published to make roof spaces electrically safe, and no random safety audits by State Electrical Authorities have commenced since 2014. And this is probably deliberate.

5. The 2019 NCC changes for 'breather' membranes introduction in residential walls, could readily expand into all residential roofs, unless challenged, for the next NCC edition cycle in 2022.

6. The need for regulations and referenced standards to be 'evidence-based', 'fit for purpose', and provide demonstrated Public Net Benefit, with physical testing of all insulation materials for simultaneous assessment of thermal and condensation features, under Dynamic State conditions.

7. Suspend the final implementation date of May 2020 for AS/NZS 4859.1 & 4859.2 (2018) until a fully open transparent public discussion is held regarding the need for a full independent review of the suite of insulation standards and House Energy Ratings. A Parliamentary Inquiry or Royal Commission is unnecessary in light of the:

    a) 2010 Senate Inquiry – "Home Insulation Program" *technical recommendations 6-11.
    b) 2014 NCCARF report – "A framework for adaptation of Australian households to heat waves"
    c) 2018 Senate Inquiry – "Current and future impacts of climate change on housing, buildings and infrastructure", which extensively cross references the 2014 NCCARF report

8. Simple thermal analogies to consider
   i) car windscreens in hot climates – reflective foil shields are always used, and not a pile of blankets draped over the windscreen. Even a child would intuitively know which product to choose.
   ii) walking down the street in hot weather, do you wear heavy woollen overcoats or light clothing?
   iii) NASA space suits cost US $5million each, with 5 fabric layers of coated aluminium, protecting the human from extreme radiant heat as well as extreme cold.

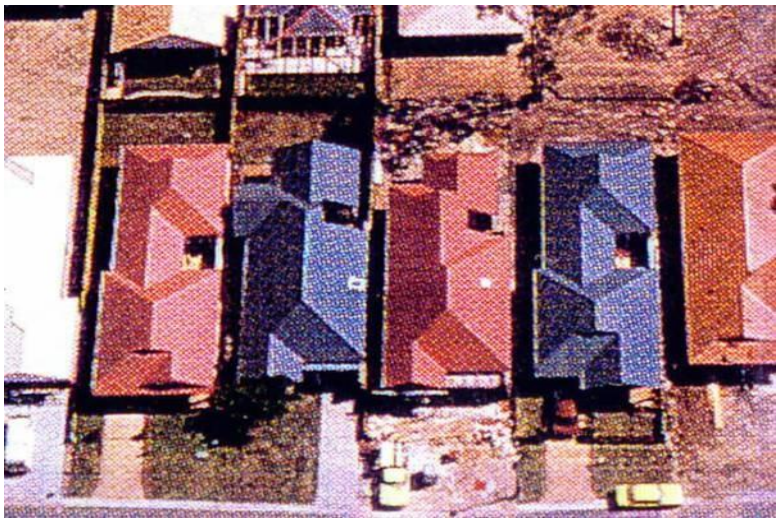
   So why are bulk insulation "blankets" forced by regulatory endorsement into houses for use in hot climates without proof of performance?

9. The regulatory juggernaut which has sanctioned greater quantities of bulk insulations into dwellings, particularly since 2004 can be likened to a truck being driven full of people with the foot steadily held on the accelerator and getting ever closer to the cliff edge. Some of the passengers are trying to stop the driver from going over the edge, but most don't seem to care - *"oh what's the point in complaining, it never gets anywhere, so we better work with the what we have".*

   The point of no return is when the first law suit is lodged, from a home owner who questions their power bills against what the Star rating is claiming, then challenges the reliability and honesty of the House Energy Ratings system and the referenced insulation standards which underpin them. Finally, the entire house energy rating scheme is found to be unsoundly based, finally implodes, and with it goes the legally referenced suite of insulation standards, because none of them are 'evidence-based' against the real world and Australian climatic conditions, and construction techniques. The truck goes right over the cliff.

10. On ABC radio in June 2019, there was an interview regarding the power of lobbying, where the person being interviewed said, "When you are enormously successful (in lobbying), you don't want to advertise it". One sector of the insulation industry has been enormously successful in lobbying since around 1975 to the present day.

11. With 50degC temperatures predicted to become more frequent in Australia, and the urgent need for greater 'heat resilient buildings', it is time for a regulatory overhaul of residential building energy efficiency policies, strategies, laws and related Standards.



TOWNSVILLE - Queensland, Australia 2011
A picture is worth a thousand words – single storey houses, jammed side by side.
Try to naturally ventilate these houses for tropical comfort – it's impossible.

APPENDIX 1 - LEGEND

AAC - Australian Aluminium Council
ABCB – Australian Building Codes Board
ACCC – Australian Competition and Consumers Commission
ADMA – Australian Ductwork Manufacturers Alliance
AFIA – Aluminium Foil Insulation Association Inc. (1998)
AFICA – Aluminium Foil Insulation Council of Australia Inc. (2019) *independent foil insulation companies
AGO – Australian Greenhouse Office (federal) – ceased to exist approx. 2007
AIRAH – Australian Institute of Refrigeration & Heating
AIMDG – Australian Insulation Discussion Group (1996-1998)
ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers
BCA – Building Code of Australia
BD-58 – Standards Committee responsible for all insulation-based standards
CFA – Consumers Federation of Australia
CIE – Centre for International Economics
CIRS-WBD – Chronic Inflammatory Response Syndrome in Water-Damaged Buildings
COAG – Council of Australian Governments
FARIMA – Fibreglass and Rockwool Insulation Manufacturers Association
HERS – House Energy Rating Scheme
HIP – Home Insulation Program 2009-2010
ICANZ – Insulation Council of Australia & New Zealand (two members – fibreglass industry)
IMAA – Insulation Manufacturers Association of Australia (2000-short lived)
MBA – Master Builders Association
NatHERS – National House Energy Rating Scheme
NCC – National Construction Code (interchangeable name with the BCA)
ORNL – Oak Ridge National Laboratories (USA, Tennessee)
PBMA – Pliable Building Membranes Association of Australia (meant to represent the foil insulation divisions of ICANZ member companies CSR Bradford & Fletcher Insulation)
RFL – Reflective Foil Laminate (most commonly known as foil sarking)
Sarking – means “to waterproof”
SA – Standards Australia
TSR – Total Solar Reflectance (see Adaptation to Heat Waves report 2013)

Note: Consumers Federation of Australia falls within the operation of the ACCC

APPENDIX 2 - Richard Aynsley PhD

University Degrees

1965	B.Arch (Hons 1) University of New South Wales, Sydney, Australia
1966	M.S. (Arch.Eng.) Pennsylvania State University, State College, PA, USA
1978	Ph.D. (Building) University of New South Wales, Sydney, Australia

Relevant Membership in Professional Societies

ASCE

1986-to date Member of American Society of Civil Engineers' of the newly formed *Technical Council on Wind Engineering* in 1986
Co-Chairman (with Professor Arens, UC Berkeley) of the Architectural Aerodynamics Sub Committee, 1986-2004.
Chair of the Council's *Environmental Wind Engineering Committee*, 1986-2004.
Chair Urban Aerodynamics Task Committee 2002- 2004.
Chair of the ASCE Aerodynamics Committee, Aerospace Division in 2004.
Affiliate member of the American Society of Civil Engineers since 1986 and Associate membership, 2012 to date.

ASHRAE

1983-to date Member of ASHRAE Technical Committee 4.3, Ventilation Requirements and Infiltration, 1983-97
Chairman of TC 2.5 Research Subcommittee - Airflow Around Buildings, 1986-89.
Committee member SSPC55 for ANSI/ASHRAE Standard 55-2004 *Thermal Environmental Conditions for Human Occupancy*, leader of review provisions for *Elevated Air Speed*. 2005-13.
Life Member American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013 to date.

AIRAH

1981-2016 Member of Australian Institute of Refrigeration, Air Conditioning and Heating Inc. 1981 and Fellow 2008-16.

AIA

1966-2011 [Royal] Australian Institute of Architects, Member 66-78, Fellow 1978-2011.

AMCA

2004-07 Air Movement and Control Association International (AMCA)
Chairman of committee to review ANSI/AMCA 230-99 standard.

BRANZ

1990-95 Member of the Building Physics Advisory Committee of BRANZ (Building Research Association of New Zealand)

TIIA

1973-1981 Member of the Thermal Insulation Institute of Australia (This merged with AIRAH in 1981).

STANDARDS AUSTRALIA

1975-2007 Member of Standards Australia technical committees, BD/57 and BD/58 Thermal Performance & Insulation of Dwellings 1975-2005
Member of Standards Australia technical committee in ME '62 Mechanical Ventilation Conditioning, Committee, 1995-7
Member as AIRAH representative to Standards Committee EN-003 *Efficiency and Thermal Performance of Buildings, 2005-2007*

Academic and University Administrative Appointments

1968	Lecturer, School of Architecture, University of New South Wales, Sydney, Australia
1970	Lecturer/Senior Lecturer, Department of Architectural Science, University of Sydney, Australia
1980	Professor and Head of Department of Architecture & Building, Papua New Guinea University of Technology, Lae, Papua New Guinea
1985	Professor, College of Architecture, Georgia Institute of Technology, Atlanta, GA, USA
1989	Professor, School of Architecture, University of Auckland, Auckland, New Zealand
1990	Professor, and Head of the School of Architecture, University of Auckland, Auckland, New Zealand (largest school in Australasia at the time)
1993	Dean, Faculty of Architecture Property and Planning, University of Auckland, NZ
1993-5	Conjoint appointment as UNESCO Professor of Tropical Architecture, James Cook University, Townsville, QLD, Australia
1995	Founding Director of the Australian Institute of Tropical Architecture, and UNESCO Professor of Tropical Architecture, James Cook Univ. Townsville, QLD, Australia
2000	Dean, College of Technology, and Professor in Construction, Southern Polytechnic State University, Marietta, GA, USA
2001-03	Dean, School of Engineering Technology and Management, and Professor in Construction, Southern Polytechnic State University, Marietta, GA, USA

End of TIMELINE