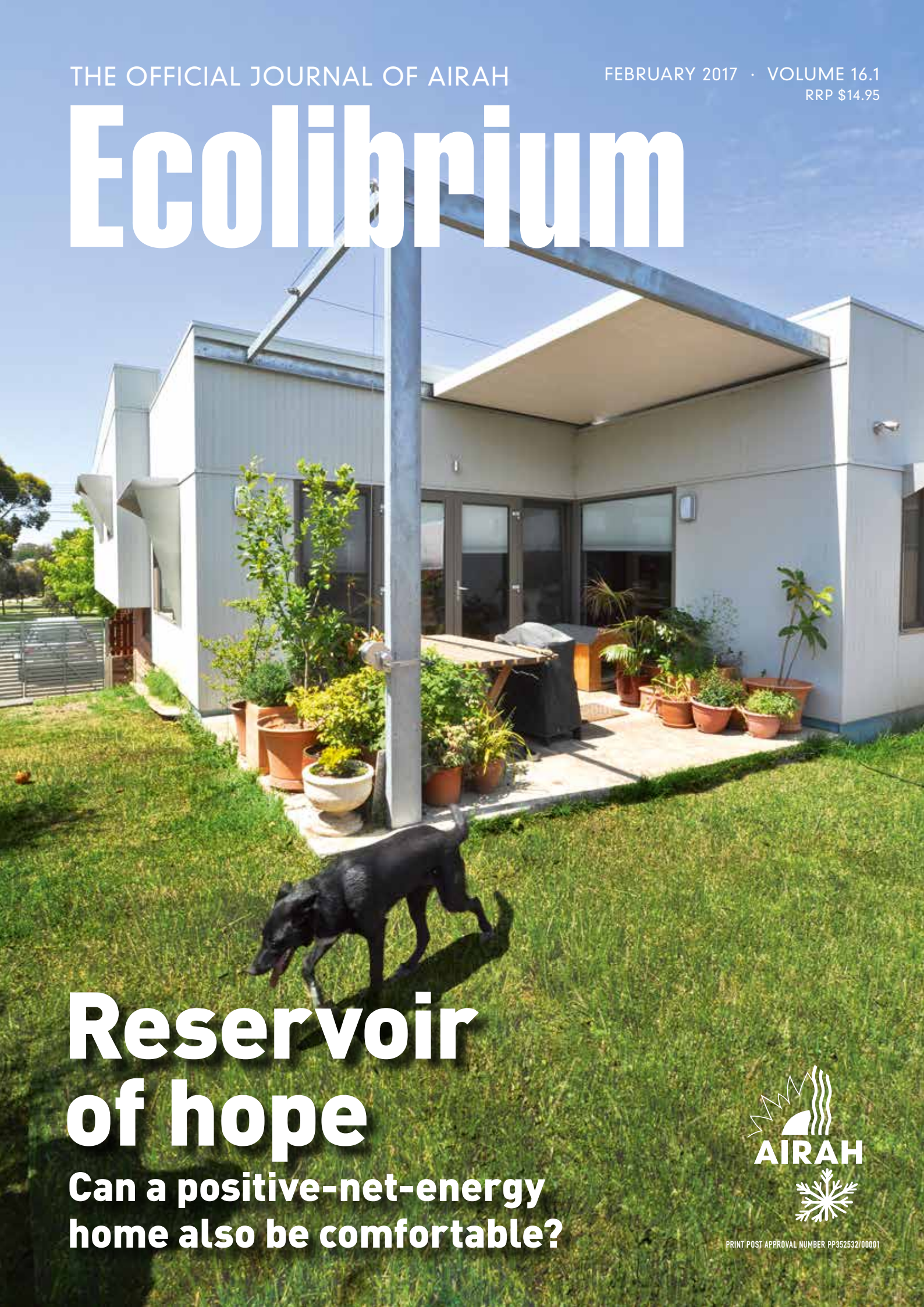
THE OFFICIAL JOURNAL OF AIRAH

FEBRUARY 2017 · VOLUME 16.1
RRP $14.95

Ecolibrium



Reservoir of hope

Can a positive-net-energy home also be comfortable?

AIRAH

PRINT POST APPROVAL NUMBER PP352532/00001

Pushing the envelope

An AIRAH Special Technical Group has brought overdue attention to residential building envelope integrity and air leakage. The impetus? A nationwide survey of newly constructed homes that found a large disparity in air tightness levels. **Sean McGowan** reports.

For some time, concerns have been raised about the ability of Australian houses to achieve the minimum energy efficiency standards as outlined in the National Construction Code (NCC). The culprit: a lack of efficient sealing.

Until late 2015, little data had been collected to quantify building envelope integrity on newly built homes. Without it, anecdotal evidence suggested the NCC's basic requirements for draught sealing in residential homes had not achieved their aim.

These concerns were realised after a 2015 nationwide survey of 129 newly constructed homes by the CSIRO found a large disparity in blower door test results – the method commonly used in overseas markets to test air leaks in buildings.

Conducted as part of the House Energy Efficiency Inspections Project authored by Michael Ambrose and Mike Syme, the CSIRO found that against a target of 10 ACH @50Pa (considered to be a "fair" air-change rate), the average across the survey was in fact 15.4 ACH_{50}.

> "There is a cultural issue based on a fallacy that . . . somehow the laws of physics do not apply in Australia"

Such a rate is considered to be at the upper threshold for a newly constructed home.

Almost half the houses tested recorded air-change rates above 15 ACH_{50}, with several recording "poor" rates above 30 ACH_{50}. Though such a figure might be expected among old, poorly sealed houses, it should not be occurring in new constructions.

The good news, however, is that around one-third of houses in the survey recorded a rate lower than 10 ACH_{50}. It demonstrates that the construction of a well-sealed house is not only possible, but occurring in Australia.

So why the disparity in results? And how can the issue of building

envelope integrity be taken more seriously in the residential building market?

These questions are being considered by the recently formed AIRAH Building Physics Special Techn ical Group (STG).

Formed in July 2016, the group's aim is to deliver building envelope systems that integrate effectively with HVAC systems. And the ultimate goal is optimal performance, by managing heat, air and moisture interactions within building envelopes.

And among its first tasks was the publication of the *Improving Australian Housing Envelope Integrity* report. This builds on the CSIRO research, and details the benefits of air sealing Australian homes to a practical level.

Jesse Clarke, M.AIRAH, is the report's lead author, and a building scientist with CSR Building Products based in Sydney. He says there is a common, climate-based perception across the industry that Australian housing does not need to be sealed.

"There is a cultural issue based on a fallacy that it is only a European or North America problem, and that somehow the laws of physics do not apply in Australia," Clarke says.

"In reality, if heating or cooling is used, there will always be a benefit in preventing the poor practice of constructing excessively air-leaky buildings. It just comes down to how much the relative cost of implementation is, and if the benefit-to-cost ratio is greater than parity."

The issue of air leakage is addressed in the NCC in the form of a performance requirement. But this does not specifically quantify a minimum air-leakage rate.

NCC Volume 2 (2015) – Clause P2.6.1 states that "a building must have, to the degree necessary, a level of thermal performance to facilitate the efficient use of energy for artificial heating and cooling appropriate to the sealing of the building envelope against air leakage."

Jesse Clarke, M.AIRAH

But according to AIRAH's Building Physics STG, compliance with the NCC's energy provisions has been shown by the federal government's National Energy Efficiency Building Project to be lacking.

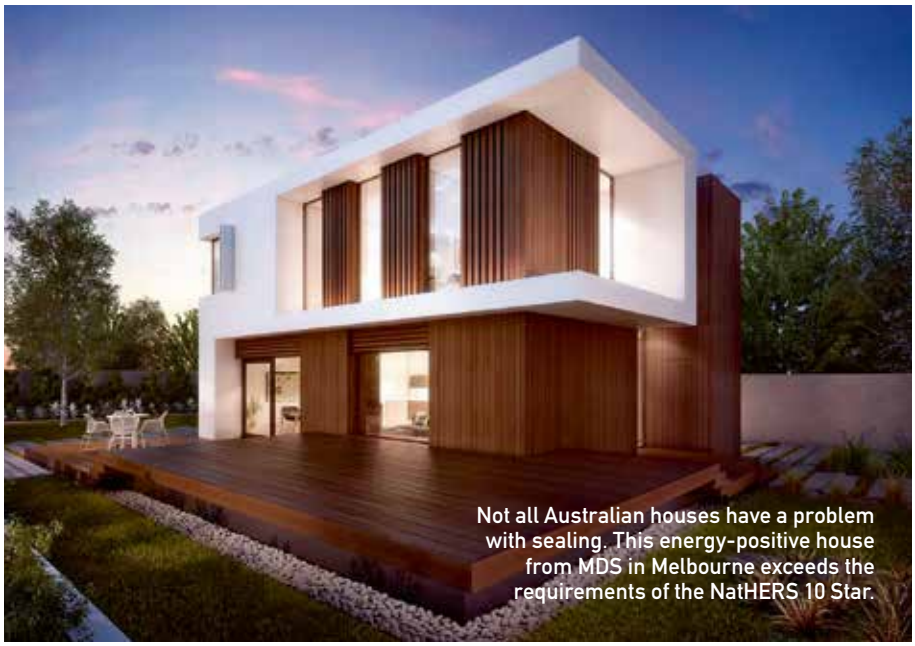
"The current wording within BCA Volume 2 is very vague," says Clarke. "And terms such as 'close fitting' and 'minimise air leakage' are impossible to quantify.

"This leads to highly variable outcomes."

Furthermore, the group believes the current process of visual verification to determine adequate sealing in accordance with the requirements of the NCC is both subjective and unreliable.

"The current lack of ability to check the performance means that it is impossible to know whether sealing is effective or not," says Clarke.

"This then becomes an issue where we are delivering homes that are too loose and will not meet the energy-efficiency objectives, or conversely delivering very well-sealed homes without proper ventilation and water vapour management, which put at risk the health and amenity objectives [of the code]."



Not all Australian houses have a problem with sealing. This energy-positive house from MDS in Melbourne exceeds the requirements of the NatHERS 10 Star.

The group supports the view that quantifiable benchmarks and post-construction performance testing are necessary to drive industry learning, competition and improve overall building performance.

"Not all Australian houses are poorly sealed," says Clarke. "Some are actually in line with international best practice, which goes to show how easy it is to do in Australian housing with just a little bit of thought."

PROPOSING CHANGE

The Special Technical Group's report presents the case that performance-based sealing and verification of as-constructed air leakage rates in new housing, in accordance with AS/NZS ISO 9972, would be of great benefit to Australia.

And the group is pushing strongly for its inclusion in the 2019 Building Code.

"Recent research by CSIRO has shown that the current prescriptive methods outlined in the BCA for sealing construction systems are not effectively achieving their purpose in 65 per cent of cases, and not fulfilling the NCC objectives to reduce carbon emissions," the report says.

Rather than calling for an increase in the stringency of the current energy efficiency provisions in BCA Volume 2, the group is advocating the use of a performance-based method of verification.

It recommends a performance target of 10 ACH_{50} is implemented as a performance-based measure in parallel with acceptable construction practice in the 2019 code revision

"A building code target value of 10 ACH_{50} would effectively bring 65 per cent of new houses tested to a Fair level of performance," the report says.

The group is also calling for the adoption of AS/NZS ISO 9972 to be used as the standard test methodology to validate performance from the 2022 BCA update.

Adopted by Australian and New Zealand Standards in 2015, this standard outlines the principal methodology to undertake post-construction verification of the thermal performance of buildings. It stipulates determination of the envelope's air permeability using the fan-pressurisation method.

"This provides a highly valuable performance-based opportunity for the building code to quantify the air-sealing requirements for energy efficiency, allowing this performance- based solution to improve productivity," says the report.

"The Australian Building Codes Board is working to increase the ability of industry to develop performance-based solutions, which foster innovation and cost-effective construction practices to realise a potential $1.1 billion per annum in productivity savings."

BENEFIT-COST

To support its recommendations of a performance-based benchmark of 10 ACH_{50} and performance verification via AS/NZS ISO 9972, AIRAH's Building Physics STG conducted an analysis of the economic benefits.

It found that an achievable and realistic Building Code performance benchmark enabling post-construction testing using AS/NZS ISO 9972 will deliver an economic benefit-cost ratio (BCR) of 1.7 @ 7 per cent discount rate for 25-year projections.

The BCR is calculated to be 2.1 @ 5 per cent discount rate and as high as 2.5 @ 3.5 per cent (IPCC) discount rate. The report does, however, recognise the impact of the provisions varies across construction types and climate zones.

The report says that depending on the location, BCR ratios for houses using simulation compliance ranged from 0.4 to 4.9 (7 per cent discount rate) on a climatic basis (excluding Northern Territory – BCA 1 and 3).

The report concludes that $255–$371 million of economic benefit could be gained from an annual investment in air-sealing technologies and practices of $146.7 million.

> "A common misconception is that the only benefit to air sealing a building is to increase the energy efficiency of the building envelope"

ADDITIONAL BENEFITS

AIRAH's Special Technical Group suggests other benefits of improved air sealing will include:

- Enhances overall innovation in manufacturing and construction sectors.
- Reduces the longer term relative risk of mortality and sickness.
- Helps safeguard occupants from illness or loss of amenity as a result of undue sound.
- Enhances capacity to protect a building from damage caused by entrance of external humidity.
- Allows highly effective low-cost balanced mechanical ventilation strategies to safeguard occupants from accumulation of internal moisture.
- Improves prevention of water penetration in walling systems
- Helps to avoid the spread of fire.
- Reduce peak load when a leaky home (35 ACH50) is sealed to a Fair level (10 ACH50) and operated with effective controlled natural ventilation strategies:
  - Peak heating load can be reduced by 21–32% in capital cities
  - Peak sensible cooling load can be reduced by 7–22% in capital cities
  - Peak latent cooling peak load can be reduced by 1–43% in capital cities
  - Peak latent cooling load reduction due to air sealing is largely due to the prevention of infiltration of humid air. In warmer tropical climates this has the largest effect.

And importantly, the cost of implementation of air-control measures is estimated to be relatively minor – ranging from $163 to $1468 per house.

ADDITIONAL BENEFITS

Firmly established international building science research has shown that improved air sealing will help achieve the NCC's objectives for health, amenity and fire safety in new homes. This, on top of returning a financial benefit.

"A common misconception is that the only benefit to air sealing a building is to increase the energy efficiency of the building envelope," say the report.

"However, the benefits range from increased energy efficiency, improved fire performance, superior acoustics, better weather tightness and enhanced ability to manage moisture and mould risks in buildings.

"This has multiple benefits to society through reduction in energy costs, reduced stress in persistent cold and extreme hot weather for susceptible demographic groups, safer buildings, better quality of life, and enhanced building longevity through controlling unintended moisture transfer and water damage."

The report also concludes that air sealing verification has the potential to mitigate 33,360 tonnes of CO_2 annually.

RECOMMENDATIONS

Along with a performance target of 10 ACH_{50} and recommending AS/NZS ISO 9972 be used as the standard test methodology to validate the performance, the AIRAH Building Physics Special Technical Group has made several other recommendations in its report.

Some of these relate to houses that achieve low air-change rates of less than 7 ACH_{50}. At this point a lack of ventilation could create an accumulation of internal moisture and promote mould growth.

Together, these will form part of a proposal that the group intends to draft and submit to the Australian Building Codes Board, for consideration in the 2019 BCA update.

"The report has received very positive feedback since its release in October 2016," says Clarke. "And many are wondering why it has taken so long to be put on the agenda." ▮

Would you like to know more?

To download the report Improving *Australian Housing Envelope Integrity*, go to www.airah.org.au/research