



ENGINEERS
AUSTRALIA

Inquiry into Apartment Design Standards in Victoria

Submission to the Parliament of Victoria
Environment and Planning Standing Committee

31 October 2021



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1. Introduction

Engineers Australia is the peak body of the engineering profession in Australia. We are a professional association with about 100,000 individual members. Established in 1919, Engineers Australia is a not-for-profit organisation, constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

Following the release of the Better Apartment Design Standards¹ and the Framework for Building Reform² it has been highlighted that the regulation of apartment construction has not kept up with the rapid pace of industry growth. It is hoped that the recommendations from these papers will lead to strengthened accountability across all construction processes, improved practitioner and industry performance, and strengthened regulatory functions. However, there is more that must be done.

Engineers Australia welcomes the Victorian Government's commitment to working with industry to deliver high quality, liveable apartment communities for the growing population however there are complex issues that must be addressed in order to achieve this goal.

Victorians need only look across the border to see the difficulties that face apartment design. The evidence as shown in NSW through their OC audits is that many apartment buildings have significant defects, related to general quality as well as safety.

In NSW, the major defects within apartment buildings relate to structural defects/failures, waterproofing (external and internal defects), fire safety, and external cladding, as well as a failure to maintain essential services.³ The reasons for these defects include poor engineering design and specification, poor construction techniques, poor construction management and site supervision and lack of sufficient inspections and proper commissioning.

Engineers Australia recommends a government-led review into apartment design, construction, and maintenance in Victoria, to include:

- Considering the whole life cycle of an apartment building including new builds and retrofitting existing buildings to meet emerging requirements.
- Consulting with experts to take a systematic approach to resolving specific issues identified in this submission
- Collecting data on liveability and exposure to undetectable (by residents) but serious structural and other back of house deficiencies within buildings, analysis of the data to make data-driven decisions and informing and educating stakeholders of the impacts.

1.1 The collaborative approach

The transparent and collaborative relationship between industry institutions and the government has never been more important. With the help of their members, industry and professional groups have shown a strong willingness to cooperate. Many of the initiatives led by these groups have contributed to the overall discussion and solutions. Our model involves consulting our expert members to provide us with the relevant technical advice. Consultation is generally undertaken through the release of discussion papers, webinars, roundtables, working groups and committees.

Engineers Australia has a strong working relationship with numerous government departments and regulatory agencies. We have regular engagement with the Victoria Building Authority, predominately through the State Building Surveyor and engagement with the Department of Environment, Land, Water, Planning as required predominately through the Executive Director of Buildings. The views of our members are highly regarded, and we have representatives across industry including on the Building Regulations Advisory Committee (BRAC), Architects Registration Board (ARB), the Victorian Skills Authority ensuring our support across various government departments.

¹ [Updated Better Apartments Design Standards \(planning.vic.gov.au\)](https://planning.vic.gov.au)

² [Engage Victoria. Framework for Reform https://engage.vic.gov.au/expert-panels-comprehensive-review-victorias-building-system](https://engage.vic.gov.au/expert-panels-comprehensive-review-victorias-building-system)

³ [Construct NSW. Improving Consumer Confidence. Research report on serious defects in recently completed strata buildings across New South Wales at September 2021](#)

We have been heavily involved in the Cladding Safety initiatives through the Cladding Taskforce and the Society of Fire Safety, Engineers Australia has been vigorously advocating the use of a risk-based approach to existing flammable cladding and has previously issued practical guidelines on this topic.⁴

Similarly, the work between the Victorian Government and Engineers Australia to legislate and implement the Professional Engineers Registration Act 2019 has helped ensure Victoria achieve some of the objectives outlined in the Building Confidence Report's implementation plan. We worked closely with the Department of Justice and Community Safety to implement the Professional Engineers Registration Scheme assisting the implementation team to understand engineering requirements and international benchmarks, provided member feedback and communicated and educated our members and industry more broadly on the scheme's implementation.

Engineers Australia has a demonstrated track record and is committed to continuing to work with the Victorian Government to promote reforms and bring lessons learned back to the industry to improve engineering practices in Victoria and across the nation.

⁴ Engineers Australia, Practice Guide on Façade External Wall Fire Safety Design (2019)

1.2 Summary of Recommendations

Consequences of Wind Action

- While the recent updates to Better Design Standards have addressed many issues around wind action, it is recommended that there be a mandate on the maximum levels of lateral building sway and the periodic acceleration that may result from wind action.

Water Ingress and Waterproofing

- It is recommended that the standards build on the guidelines issued by the NCC and improve the waterproofing requirements for Class 7a and 7b spaces to limit potential damage to parking and storage spaces

Ventilation

- Engineers Australia recommends collecting case studies and data on COVID-19 exposure events where ventilation has been a factor and develop advice about what can be learned about the design of buildings from these case studies.

Fire Safety Systems

- It is recommended that Victoria implement regulatory reforms to improve both the design and construction process for fire safety systems within apartment buildings through further investigation into defects found in existing buildings.

Electrification

- Engineers Australia recommends further investigations be conducted into the ability of apartment buildings to handle high levels of electrical loading due to the forecasted increase of electric vehicle ownership and how this can be improved, as well as the associated fire safety risk in indoor carparks.

1.3 Contact details

To discuss this submission further, please contact Alesha Printz, General Manager – Victorian Division Engineers Australia, at aprintz@engineersaustralia.org.au.

2. Structural Consequences of Wind Action

Engineers Australia welcomes the Department of Planning's recent draft of "Wind Impacts in Apartment Developments Practice Notes" in addressing some of the key issues surrounding designing for wind in apartment buildings five stories or more.⁵ "The standard requires an assessment of wind impacts and the level of wind speed to be achieved to ensure both safety and comfort for pedestrians and people using outdoor areas."⁶

2.1 Wind Induced Motion Sickness

While the "Wind Impacts in Apartment Developments Practice Notes" has addressed many of the issues regarding impact on public safety in proximity to the building, they have not addressed the effect of wind action for occupants within the building itself. Recent trends towards tall, slender, flexible, and light-weight buildings have resulted in a large number of buildings being susceptible to wind induced motion and human perception of building motion has become a critical consideration in modern building design. The perception of acceleration or motion within a building can cause unease and motion sickness for occupants.⁷

Human perception of movement in what is perceived to be a "solid" structure is a key cause for unease within high rise buildings. This is most affected by the amount of lateral sway deflection (the amount the top of the building moves from its original position under loading) within the building.⁷ Accelerations due to this wind action can create imbalances within the inner ear leading to motion sickness in sensitive individuals.

People's reaction to a high-rise building's wind-induced movement depends on many cues, including: movement, noise, visual observation, and comments of others in the same building.⁷ The main goal of a good design that relates to impacts of wind is to provide an environment in which the occupants of the building feel safe and do not notice the effect of wind loads on the building. Since movement tolerance is a subjective value that varies from person to person, the amount of building swing allowed by the owner and the occupant may be different.

The joint Australian and New Zealand Standard AS/NZS 1170.2:2021 *Structural design actions, Part 2: Wind actions* currently sets the standards of building reactions to the effect of wind loading. However, limits on building acceleration due to wind effects are guidance only. Arguably limits on acceleration consequent of periodic motion due to wind action, as well as limits on lateral sway deflection should be mandated. Limiting both acceleration and lateral sway deflection are essential to helping occupants feel safe and comfortable within an apartment and should be fundamental considerations for any apartment design.

⁵ [Wind Impacts in apartment developments Practice Notes \(2021\)](https://www.planning.vic.gov.au/data/assets/pdf_file/0021/514164/Apartment-Design-Guidelines-Final-Draft-Report_280221_a.pdf)
https://www.planning.vic.gov.au/data/assets/pdf_file/0021/514164/Apartment-Design-Guidelines-Final-Draft-Report_280221_a.pdf

⁶ [Updated Better Apartments Design Standards \(planning.vic.gov.au\)](https://www.planning.vic.gov.au)

⁷ [Hansen, Reed, and VanMarcke, Human Response to Wind-Induced Motion of Buildings \(1979\).](https://www.aisc.org/globalassets/aisc/awards/tr-higgins/past-winners/human-response-to-wind-induced-motion-of-buildings.pdf)
<https://www.aisc.org/globalassets/aisc/awards/tr-higgins/past-winners/human-response-to-wind-induced-motion-of-buildings.pdf>

3. Water Ingress

Water ingress is an issue that affects apartment design across Australia. A survey undertaken by the NSW Strata Community Association has identified that a significant proportion of newly completed class 2 buildings have defects, with insufficient waterproofing being the largest single category of defects⁸.

Defects aside, there are inconsistencies within waterproofing standards that can cause concern for end users.

Parking and storage spaces within buildings are classified as Class 7a or 7b according to the NCC⁹ which does not mandate complete waterproofing for these areas. Typically, waterproofing involves membranes or water stops adhered to structure and/or waterproofing admixtures added to the concrete mix. However, frequently basement walls in apartment buildings are not waterproofed and are designed as “wet-walls” with a catch drain at the base. As a result, when the inflow volume of water to such spaces is large and drainage measures fail, it can result in detrimental effects to cars and non-durable items stored in “cages” or enclosures. Quite often electrical appliances or car stacking equipment are fixed to surfaces over which water may flow (viz. perimeter walls). In addition, water penetrating through overlying external surfaces and/or planters is typically laden with carbonates from cement and is caustic and damaging to the equipment and building structures.

The foregoing issue of insufficiently controlled water penetration into basements is widespread. The experience of our members is that the stipulation for the amount of acceptable inflow water into class 7a and 7b areas is ill defined. Significant amounts of water flowing into basement car-parking or storage spaces is considered unacceptable to end use consumers and would suggest that this should be addressed by government.

In general, there are widespread issues with waterproofing to apartment buildings above and below ground. Our recommendation would be that standards are reviewed and improved with respect to the NCC and the relevant Standard(s) - [Australian Standard AS 4654.1-2012 *Waterproofing membranes for external above-ground use, Part 1: Materials*] and that further investigations be conducted into the acceptable level of water inflow into class 7a and 7b structures that avoids damage to the objects within.

⁸ [Construct NSW, Improving Consumer Confidence, Research report on serious defects in recently completed strata buildings across New South Wales at September 2021](#)

⁹ [NCC Volume 2, https://ncc.abcb.gov.au/ at October 2021](https://ncc.abcb.gov.au/)

4. Ventilation

COVID -19 has exposed the poor levels of indoor air quality standards within apartment buildings. There has been record of transmission between apartments through common areas including foyers, lifts, stairwells and amenities (laundry, gym, pool) even with fleeting contact (e.g. Southbank, Vic). In some cases, the Stack/Reverse Stack effect (where air moves vertically through the building due to differences in outdoor and indoor temperature) has enabled air to travel between apartments above and below each other through naturally ventilated bathrooms.¹⁰

The issue of indoor air quality and performance of buildings in Australia has been a concern of many in the industry for some time. Some observations from our members indicate that this is a topic worth exploring further to understand the ranging perspectives and aspects, given its importance to human health:

- The State of the Environment Report (2016)¹¹ references a 2015 paper, stating “Indoor air quality and occupational exposure may also be increasing pressures [defined as events, conditions or processes that result in degradation of the environment], but these remain poorly measured and monitored”.
- The sustainability of Heating Ventilation and Air Conditioning (HVAC) systems especially in regard to energy efficiency is critical given the energy consumption of these systems and the relative inefficiency of ageing assets.
- The question of who bears responsibility for air quality within an apartment building is still up for debate. For tenants, the ability to improve indoor air quality is limited as they can only influence that which is in the bounds of their apartment. There is little to no incentive for building owners to improve air quality as there are no specific guidelines around indoor air quality.

In October 2021 Engineers Australia published a discussion paper, *The COVID-19 pandemic and HVAC: Problem and opportunity analysis*.¹² The paper is designed to elicit feedback that will inform decisions by Engineers Australia on its potential role regarding improving engineering practice for management of air in the built environment, especially in the context of COVID-19 and future pandemics.

Amongst the recommendations put forward for discussion in this paper is that case studies and data should be collected on COVID-19 exposure events where ventilation has been a factor, including both super spreader events and the cases where significant spread has not occurred. Based on the case studies, further advice about the design of buildings can be developed. It is critical that this data is collected contemporaneously for future reference in the development and improvement of regulation, standards, and other guidance.

¹⁰ [S.E Hwang, J.H.Chang, B.Oh and J.Heo, Possible aerosol transmission of COVID-19 associated with an outbreak in an apartment in Seoul, South Korea, 2020 https://www.sciencedirect.com/science/article/pii/S1201971220325583](https://www.sciencedirect.com/science/article/pii/S1201971220325583)

¹¹ [State of Environment Report \(2016\) https://soe.environment.gov.au/theme/overview/headlines-at-october-2021](https://soe.environment.gov.au/theme/overview/headlines-at-october-2021)

¹² [Astrid Kaufmann, The COVID-19 pandemic and HVAC: Problem and opportunity analysis, Engineers Australia \(2021\). Available at: https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-10/covid-19-pandemic-hvac-analysis.pdf.](https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-10/covid-19-pandemic-hvac-analysis.pdf)

5. Fire Safety Systems

The Building Confidence Report and the Framework for Building Reform¹³ have both highlighted the need for reform to fire safety design systems within buildings. Indeed, many states' BCR implementation plans¹⁴ involve specific items regarding fire safety systems.

The survey undertaken by the NSW Strata Community Association has identified fire safety system defects being the second largest category of defects within strata controlled buildings.¹⁵ It is important to learn from the findings in NSW and investigate for similar issues in apartment buildings in Victoria.

For fire safety systems, the cost of false automatic fire alarms that reflect design, installation, and maintenance defects as well as other factors, was found to have an annual impact in NSW over \$100million per annum.¹⁶ This covered the direct cost on Fire and Rescue NSW and other fire safety responders and the broader cost on the community and economy. These defects stem from issues including:

- Quality and adequacy of some fire protection system designs.
- Some non-complying fire protection system installations and the non-detection of same as part of the certification process.
- Some fire protection systems not being properly maintained.
- Design, approval, implementation, and maintenance of some Alternative Solutions involving fire safety matters.
- Adequacy of communication of fire protection system and important Alternative Solution information to end users (i.e. fire authorities, maintenance contractors, owners and occupiers [current and prospective]).
- Some fire safety practitioners with insufficient up to date technical knowledge with respect to fire safety systems, and insufficient understanding of the related legislative framework which regulates buildings in NSW.¹⁷

In response to this, the NSW government passed the Design and Building Practitioners Act 2020 and Regulation 2021 in a major legislative and regulatory effort to try and improve standards of apartment buildings in every aspect of design. Construction NSW is also in the process of publishing the "Industry Report on Reforms to Improve Fire Safety in Completed Buildings" outlining a further set of reforms for fire safety quality, safety, and standards for all buildings in NSW, including apartments, with plans for the reforms to be introduced in 2023.

Engineers Australia commends the efforts that the Victorian government has made to enhance enforcement and compliance of fire safety systems through the Victorian Cladding taskforce and the Victorian Building Regulations 2018, however it is recommended that Victoria take further steps to improve both the design and construction process to lift the standard of the industry. Investigations into the cause of existing defects within apartment buildings has led to the wholesale reform seen in NSW. Further investigations and reforms to improve the standard of fire safety quality for all building, including apartments should be a consideration for the committee.

¹³ [Engage Victoria. Framework for Reform https://engage.vic.gov.au/expert-panels-comprehensive-review-victorias-building-system](https://engage.vic.gov.au/expert-panels-comprehensive-review-victorias-building-system)

¹⁴ Building Confidence Report: Implementation Plan <https://www.industry.gov.au/data-and-publications/building-confidence-report-implementation-plan>

¹⁵ [Construct NSW, Improving Consumer Confidence, Research report on serious defects in recently completed strata buildings across New South Wales at September 2021](#)

¹⁶ N. Gladstone, False Fire Cost Taxpayers \$100 Million a year <https://www.smh.com.au/national/nsw/false-fire-cost-taxpayers-100-million-a-year-20200220-p542j2.html> at 22 February 2020

¹⁷ NSW Fire Protection Working Party Final Report, October 2010

6. Electrification

As the world moves toward more climate friendly solutions, it can only be expected that apartment design will also move towards a carbon zero *modus operandi*. This move to carbon neutral living brings with it issues that must be considered.

The electrification of many utilities such as cook tops and heaters, raises the question whether building systems can support the additional electrical load. Not only should the replacement of gas for cooking and heating with electricity be considered, but the shift to electric vehicles means that a few token chargers in a building will not be adequate to provide for occupants of a building. To achieve net zero by 2050, it is recognised that we will have to move away from Internal Combustion Engine vehicles very quickly and the number of electric vehicles is predicted to increase greatly.¹⁸ It is recommended that further investigations be conducted into whether building electrical systems have the capability to support this additional loading and, if not, what would be required to achieve this.

In addition to consideration of the capacity of building electrical systems, another emerging issue is the requirement for carparks, particularly enclosed car parks and car stackers, to accommodate electric vehicles (EVs) and E-bicycles due to the risks of thermal runaway of Li-Ion batteries and resultant fires and toxic gases.¹⁹ When an electric vehicle is parked it is not de-energized meaning that current still runs through the system in small amounts. There is a risk that is posed by electrical faults/malfunctions in a vehicle which is never truly turned off.

Apartment occupants will not be able to independently install vehicle charging in their own apartment and garage-installation in a building as this will require cooperation from the building manager and body corporate (or equivalent) and funding. There may be some instances where building managers/body corporates are unwilling to bear the extra cost and risk of installing EV Power stations. Further guidelines around the process which owners can take to install EV power stations are required and should be considered by the committee.

¹⁸ Graham and Havas, Electric Vehicle Projections (2021); https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/csiro-ev-forecast-report.pdf?la=en

¹⁹ C. Panasiewicz Electric Vehicles and the Unique Risks Insurers Need to Consider; https://origin-and-cause.com/wp-content/uploads/2019/12/OC_Article_ElectricVehicles.pdf

7. Conclusion

The building industry is going through a period of rapid change. With the continued collaborative and tireless efforts made by regulators, industry and professional bodies, and practitioners, Engineers Australia is confident that a better future will be achieved in the long term.

This submission explains the urgency of implementing improvements that can be made to the liveability of apartments and apartment building developments, including communal areas. In particular, mandating standards on key areas such as wind loading, waterproofing, ventilation, and further investigation into fire safety design and electrical load capacities of buildings are important for further consideration.

Engineers Australia is aware that the next stage of the Review of the Building and Regulatory system is to commence in early 2022. That review is the next important milestone in the development of Victorian building sector reforms. It is suggested that the outcomes of this inquiry be considered and coordinated with the Stage 2 review program as it will cover all aspects of the regulatory framework: the Act, Regulations, associated guidelines, and their implementation.

Collaboratively, we can achieve a safe, liveable and sustainable building industry and increase consumer confidence in the sector.



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