ENGINEERING RESILIENT FACADES

Performance and Compliance for Australia's Diverse and Demanding Climate

Network Architectural

Introduction

Australia’s climate is undergoing rapid and profound changes, as highlighted in the State of the Climate Report 2024 released by CSIRO and the Bureau of Meteorology.[1] The report reveals an increase in extreme heat events, longer fire seasons, more intense heavy rainfall, and rising sea levels. These changes, driven by growing concentrations of greenhouse gases in the atmosphere, are profoundly impacting the built environment and facade design.

Rising temperatures are exacerbating heatwaves, which now occur with greater intensity and frequency. This relentless heat can compromise the structural integrity of facade materials, accelerating wear and thermal expansion. Simultaneously, reduced rainfall in southern regions during cooler months has become a permanent feature, leading to drier conditions that heighten the risk of drought and bushfires.

The built environment faces significant challenges due to the country’s extreme and varied climate conditions. As the first line of defense, facades must be resilient enough to withstand harsh weather elements while maintaining their structural and functional integrity. Architects must prioritise solutions that not only protect buildings from environmental stresses but also ensure occupant safety, comfort, and long-term performance.

This whitepaper delves into the critical aspects of designing resilient facades, with a particular emphasis on the relevant codes and standards governing weather resistance. It helps architects understand what it takes to create durable, high-performing facade systems that meet the demands of Australia’s diverse and demanding climate.

Key indicators of Australia's changing climate

- Australia has warmed on average by up 1.47+/- 0.24 degrees Celsius since 1910.[2]
- Since 2000, the global frequency of droughts has risen by 29%.[3]
- Since the 1950s, large parts of Australia have experienced an increase in extreme fire weather and longer fire seasons.[4]
- Evidence indicates that heavy rainfall events in Australia have become more intense over time.[5]

Role of facades in protecting buildings

Facades are the primary barrier between a building and the elements, providing essential weather resistance to safeguard against rain, wind, snow, and extreme temperatures. By preventing water ingress and shielding the structure from harsh environmental conditions, facades protect interior spaces from water damage, structural deterioration, and long-term degradation.

Strong wind events pose a significant threat to **structural integrity**, particularly in storm- and cyclone-prone regions. Facades are designed to provide the necessary structural stability to withstand high-pressure forces and prevent detachment or deformation.

Facades act as **thermal barriers** that regulate heat transfer between the building's interior and exterior. This function ensures cooler indoor environments during summer and warmer conditions in winter, protecting interior finishes from extreme temperature fluctuations and maintaining a comfortable indoor climate.

Effective waterproofing is a critical aspect of facade design. Sealing and drainage systems prevent water infiltration, safeguarding the building against mould, rot, and the degradation of materials. Properly engineered facades ensure the structure remains dry and functional, even in prolonged exposure to heavy rainfall or flooding conditions.

UV protection is another vital function of facades, as they shield interior spaces from harmful ultraviolet radiation. This reduces the fading and deterioration of furnishings, finishes, and materials, preserving the aesthetic and functional quality of interior spaces over time.

In bushfire-prone areas, the **fire resistance** of facade materials plays a crucial role in preventing flames from spreading into the building. By incorporating Bushfire Attack Level rated materials as required by the relevant codes and standards, facades protect buildings from the mechanisms that pose a risk to buildings in these areas during a bushfire, including flame contact, ember attack, radiant heat, wind, and smoke.

Performance requirements and testing

Meeting facade performance compliance and testing standards is essential in the face of a changing climate to ensure buildings can withstand increasing environmental stresses. Rigorous testing verifies that facades meet requirements for weather resistance, thermal efficiency, wind loads, fire safety, and waterproofing. This not only protects occupant safety and comfort but also mitigates risks of structural failure, material degradation, and costly repairs.

As extreme weather events become more frequent and intense, compliance provides a critical benchmark for resilience.

National Construction Code

Structural provisions

Section B of the NCC 2022 Vol. 1, specifically B1P1, states that a building or structure must demonstrate adequate performance during both construction and use. It must reliably withstand all reasonably anticipated design actions as well as extreme or frequently repeated design forces. These actions include, but are not limited to, wind, earthquake, rainwater, snow, thermal and seismic actions.

The Deemed-to-Satisfy (DtS) solution for B1P1 is outlined in B1D2 and B1D3 of the NCC. According to B1D2, a building's resistance must exceed the most critical action effect, which is derived from various combinations of actions. The process for determining this critical action effect is specified in B1D3, using the general design procedures outlined in AS/NZS 1170 (discussed below). B1D3 provides the methodology for determining the magnitude of individual actions by referencing the relevant sections of AS/NZS 1170. The resistance of a building or structure is calculated as per the guidelines in B1D4.

Weatherproofing provisions

The weatherproofing requirements for facades and cladding systems are outlined in F3P1 of the NCC 2022 Vol. 1. According to F3P1, external walls must prevent water penetration that could lead to unhealthy or unsafe conditions, loss of amenity for occupants, or excessive dampness and deterioration of building elements. Compliance of an external wall with F3P1 is verified through the testing procedures specified in F3V1.

The DtS provisions for F3P1 address roof coverings (F3D2), sarking (F3D3), glazed assemblies (F3D4), and wall cladding (F3D5). Under F3D5, metal cladding that meets the requirements of AS 1562 "Design and Installation of Metal Roof and Wall Cladding" is considered compliant. These provisions ensure that facades and cladding systems are designed and installed to maintain effective weatherproofing.

Fire resistance and bushfire requirements

Under Section C of the NCC 2022 Vol. 1, buildings must include elements, such as external walls, that resist fire spread and maintain structural stability during a fire. These requirements are detailed in Parts C1 to C4. Specifically, C1P2 mandates that building elements, including external walls, must prevent fire spread. For external walls, compliance with C1P2 is determined using Verification Method C1V3.

C2D10 is another key provision, requiring that all external and common walls in Type A or B construction be "non-combustible." C2D10(5) identifies materials considered non-combustible, such as aluminium. C2D10(6) allows the use of pre-finished metal sheeting with a combustible surface finish not exceeding 1 mm and a Spread-of-Flame Index of 0. Additionally, bonded laminate materials can be used if all laminae, including the core, are non-combustible and meet specific conditions under C2D10(6)(g).

The NCC also outlines bushfire construction requirements for various building classes, detailed in Part G5, which addresses construction in designated bushfire-prone areas. AS 3959:2018 "Construction of Buildings in Bushfire-Prone Areas" serves as the primary standard for bushfire-resistant design.

AS/NZS 1170 Structural design standards

The AS/NZS 1170 Structural Design Standards provide a comprehensive framework for building structural design, detailing procedures and requirements to ensure structural safety and performance under various environmental loads. These standards address design values for wind, snow, ice, earthquake actions, and other loads, offering clear guidance for different conditions. They define two critical limit states for structural testing: the Serviceability Limit State (SLS), which ensures the structure remains functional and comfortable under normal usage, and the Ultimate Limit State (ULS), which guarantees the structure's stability and safety under extreme conditions.

Of note is AS/NZS 1170.2, which focuses on wind actions. This standard is essential for designing facades in extreme climates as it provides comprehensive guidelines for assessing wind loads on buildings and structures. Facades must withstand the significant pressures and suction forces caused by high winds, storms, and cyclones to prevent structural failure or detachment. By accounting for variables such as regional wind speeds, terrain, building height, and shielding effects, this standard ensures that facade designs are robust enough to handle the most severe wind events.

AS/NZS 4284:2008 “Testing of Building Facades”

AS/NZS 4284:2008 outlines the testing procedures for building facades, focusing on their performance in structural stability and weatherproofing. This standard builds on the SIROWET method developed by CSIRO to simulate wind-driven weather conditions. Key tests include the weathertightness test, which detects water seepage and visible moisture on the facade’s internal surface, and the displacement/deflection test, which measures the movement of the facade under stress.

Additionally, facades are subjected to wind pressure and static/cyclic water pressure tests to assess their strength and durability under extreme environmental conditions.

Structural testing under AS/NZS 4284 evaluates facade performance against both the SLS and ULS criteria. Additional testing parameters include assessing performance under seismic loads, and the durability of seals, providing a comprehensive evaluation of facade reliability and functionality.

First testing standards

Fire testing is a critical component in ensuring the safety and compliance of facade systems. AS 1530.1:1994 “Combustibility Test for Materials” defines the criteria for materials to be classified as “non-combustible.” Materials that meet these requirements are permissible as non-combustible materials for various building applications.

For Performance Solutions, Verification Method C1V3 in the NCC 2022 Vol. 1 is used to assess the potential for fire spread on external walls. This method references AS 5113:2016 “Fire Propagation Test of Exterior Walls”, which evaluates facade systems under real-world fire conditions. Key criteria for compliance include no flame spread beyond the edge of the test specimen, no flaming debris on the ground for more than 20 seconds, and a maximum of 2kg of fallen debris. Additional requirements, such as incorporating sprinklers, may also apply depending on the design context.

The Bushfire Attack Level (BAL) rating is determined using AS 1530.8.1:2007 and AS 1530.8.2:2007, which assess the performance of materials and systems exposed to bushfire conditions. These standards provide the basis for designing and selecting construction elements that meet specific BAL requirements, ensuring enhanced safety and resilience in bushfire-prone areas.

Coating performance for aluminium panels

The AAMA (American Architectural Manufacturers Association) standards (2603, 2604, and 2605) establish performance criteria for organic coatings on aluminum extrusions and panels, ensuring their suitability for various environments and applications, particularly in extreme climates. These standards assess critical factors such as gloss retention, colour retention, chalk resistance, and erosion resistance through rigorous accelerated weathering tests simulating years of environmental exposure.

AAMA 2605, the highest standard, requires coatings to withstand at least 10 years of outdoor exposure in harsh conditions, such as high UV areas, while maintaining exceptional resistance to fading, chalking, and gloss loss. For facades in extreme climates, these coatings are vital as they protect against severe weathering, UV damage, and erosion, ensuring structural durability and maintaining aesthetic appeal over time. This testing regime is essential to ensure facades can endure the challenges of extreme environments while providing long-term performance and reliability.

ALPOLIC'S ROLE IN CREATING RESILIENT ARCHITECTURE FOR CHANGING CLIMATE

ALPOLIC™ panels, manufactured in Japan by Mitsubishi Chemical Infratec Co., Ltd, are a superior choice for architects aiming to address the challenges of Australia's extreme climate. These panels undergo rigorous testing to meet or exceed international standards, including AS 4284 for water resistance and AAMA 2605 for coating performance, ensuring exceptional resilience against corrosion, UV degradation, and extreme weather events such as cyclones. Engineered with high-quality aluminum and advanced Lumiflon FEVE paint coating technology, ALPOLIC™ panels maintain their structural integrity, aesthetic appeal, and resistance to denting and thermal expansion for up to 50 years, even under harsh environmental conditions.

Iconic structures such as Queensland's Q1 Tower and the Queensland Children's Hospital demonstrate ALPOLIC™'s exceptional durability and weather resistance. The Q1 Tower has maintained its structural and visual integrity for over two decades despite constant exposure to salt air and intense sun, while the Children's Hospital continues to showcase vibrant colours and an immersive design ten years post-construction, withstanding Brisbane's tropical heat and humidity. ALPOLIC™ panels' ability to minimise thermal expansion and their non-combustible mineral core, certified to Euroclass A1 standards, further solidify their suitability for areas prone to extreme temperature variations and bushfires.

In addition to durability and resilience, ALPOLIC™ offers sustainability benefits by reducing maintenance and replacement needs, thereby lowering costs, resource consumption, and environmental impact. As climate change intensifies, specifying high-performance materials like ALPOLIC™ allows architects and construction professionals to create resilient, sustainable structures that can endure Australia's volatile weather while contributing to a greener future.

ALPOLIC™ panels are available from **Network Architectural**.

REFERENCES

[1] CSIRO. “State of the Climate 2024.” CSIRO. https://www.csiro.au (accessed 1 January 2025).

[2] NSW EPA. “Increasing frequency and intensity of extreme weather events.” NSW EPA. https://www.epa.nsw.gov.au/your-environment/climate-change/trends/extreme-weather-events (accessed 1 January 2025).

[3] Ibid.

[4] Above n 1.

[5] Ibid.

All information provided correct as of January 2025.

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