Energy-Efficient Facades:

Understanding Section J NCC 2019 for Windows and Doors

ALUMINIUM SYSTEMS SPECIALISTS

INTRODUCTION

As demand for infrastructure and urban development grows, one of the Australian design and construction industry's biggest challenges is implementing an effective strategy for reducing built environment emissions.

The National Construction Code (NCC) of Australia – a performance-based code that sets the minimum requirements for all new buildings and building work – plays a critical role, setting mandatory minimum requirements for energy efficiency and sustainability.

In 2019, the updated version of the NCC came into effect, which included the biggest overhaul of the decade of the energy efficiency provisions that apply to commercial and residential buildings. Modelling has shown that buildings constructed under the NCC 2019 could see a 30% increase in energy efficiency compared to buildings constructed under the NCC 2016.[1]

Rewritten almost in its entirety, Section J Energy Efficiency is the energy efficiency compliance benchmark for modern Australian buildings. Among the more notable changes are the new provisions impacting the external facade, including windows, doors and wall-glazing construction, that apply to commercial buildings in Classes 2-9.

In this whitepaper, we take a closer look at the changes to Section J, with a particular focus on the new requirements for external facades. We also discuss in detail how these changes impact specification and building design.

Above: PROJECT: genU Karingal St Laurence, VIC. ARCHITECT: NOW Architecture. BUILDER: Four Square. FABRICATOR: PW Glass Pty Ltd. PHOTOGRAPHER: Daniel Fuge.

Cover: PROJECT: Kurrawa Surf Club, QLD. ARCHITECT: Arkhefield. BUILDER: Paynter Dixon. FABRICATOR: Aluminium Balustrades Burleigh Heads.

PROJECT: 808 Sydney Rd, Brunswick, VIC. ARCHITECT: Carr Design. BUILDER: Pace Development Group. FABRICATOR: ODS Glass Pty Ltd. PHOTOGRAPHER: Glenn Hester.

COMPLYING WITH THE NCC 2019 – SECTION J

DEEMED-TO-SATISFY AND PERFORMANCE SOLUTIONS
Compliance with the performance requirements in Section J can be achieved via a Deemed-to-Satisfy (DTS) Solution or a Performance Solution. A DTS solution follows the appropriate DTS Provisions in the NCC, which outline the materials, components, design factors, and construction methods that, if used, are deemed to meet the performance requirement.[2] A Performance Solution is a solution tailored to meet the intended objective of the performance requirement and is verified using one or more Assessment Methods, including evidence of suitability, a Verification Method, expert judgment or comparison with the equivalent DTS solution.[3]

Verification Method JV3 can be used to verify that a Performance Solution is acceptable for non-residential buildings. The JV3 method is a modelling pathway that checks for compliance by comparing the overall greenhouse gas emissions of new buildings, in relation to their location and climate, to a reference building. The JV3 pathway now also includes a requirement to meet a thermal comfort level for 95% of the area for 98% of the time.

Verification Methods JV1 and JV2 are also available. These methods enable compliance by meeting the requirements of the National Australian Built Environment Rating System (NABERS) for Offices and Green Star respectively. The remainder of this whitepaper will focus primarily on Section J performance requirements and the corresponding DTS Solutions.

BUILDING CLASSES
There are distinct differences between building classes under the NCC. In relation to energy efficiency requirements, the most important factor relates to the function and use of the building.

An office building (Class 5) may only be in use during work hours whereas a hotel (Class 3) is in use 24 hours a day. In this example, if a building is in use 24 hours a day, the energy efficiency requirements for that building will be relatively more demanding than for a building that is only in use for limited hours.

SECTION J PERFORMANCE REQUIREMENTS – WINDOWS AND DOORS

JP1 ENERGY USE

Under Performance Requirement JP1, a building must have features that facilitate the efficient use of energy appropriate to the function and use of the building, the level of human comfort required for the building, solar radiation being used for heating and controlled to minimise energy used for cooling, the energy source of services and the sealing of the building envelope against air leakage.

In addition, JP1(f) provides for a quantifiable level of performance through a conditioned space that is calculated as the hourly regulated energy consumption, averaged over the annual hours of operation.

J1.5 WALLS AND GLAZING

Total System U-Value and Total R-Value In Part J1, J1.5 provides the DTS Solution for walls and glazing to meet JP1. Under this DTS provision, wall-glazing construction for specific building classes must not exceed a specified Total System U-Value. This highlights a key change in Section J, that is a greater emphasis on the principle that overall facade performance is more important than the performance of individual components.

“Wall-glazing construction” refers to the combination of wall and glazing components comprising the building envelope but excludes display glazing and opaque non-glazed openings such as doors, vents, penetrations and shutters.

Total System U-Value for the whole facade is calculated as an area weighted average of the U-Value of each component. In general, U-Values are used to measure the effectiveness of a building's fabric or its components as insulators.[4] In other words, how effectively the building fabric can prevent heat from transmitting between the inside and outside of a building.[5] The closer the U-Value is to zero, the better the insulating properties of the building element.

PROJECT: 7 Ormond by MAB Corporation, VIC. ARCHITECT: Watson Young Architects.
BUILDER: Maben Group. FABRICATOR: PW Glass Pty Ltd.

PROJECT: Pridham Hall, University of SA
ARCHITECT: JPE Design Studio
BUILDER: Mossop Constructions
FABRICATOR: Reliable Glass/Dickson
PHOTOGRAPHER: Mark Syke

In J1.5(d), a minimum Total R-Value backstop for wall components is provided. Where the wall is less than 80%, for example a mainly glass building with spandrel panels, the wall components of the wall-glazing construction must meet a minimum Total R-Value of R1.0. If the wall is more than 80%, the minimum Total R-Values for wall components are provided in Table J1.5a.

Spandrel panels are covered in Specification J1.5b. This specification details configurations of spandrel panels and the corresponding thermal performance values. A well-detailed and insulated spandrel panel can make a difference when designing facades that comply with Section J's more stringent energy efficiency requirements.

SOLAR ADMITTANCE

In addition to the increased requirements for window and wall U-Values, there are also very strict guidelines for solar heat gains. The NCC requirements for solar admittance are expressed using the Solar Heat Gain Coefficient (SHGC) value, which measures how readily heat caused by sunlight flows through the window system. SGHC is expressed as a decimal between zero and one – the lower the value, the less solar heat is transmitted.

The maximum solar admittance for wall-glazing construction varies by building type. For a Class 2 common area, a Class 5, 6, 7, 8 or 9b building or a Class 9a building other than a ward area, the maximum SHGC values are set out in Table J1.5b. Class 3 or 9c buildings, or a Class 9a ward area, must not exceed the SHGC values in Table J1.5c.

CALCULATING FACADE PERFORMANCE

The Australian Building Codes Board has published an NCC 2019 facade calculator that assists in understanding and applying the J1.5 Building Fabric DTS Provisions.[6] This should be used early on in the building design phase to work out what the U-Value and SHGC requirements will be and to assist in specifying the correct wall and window products to achieve compliance.

SECTION J PERFORMANCE REQUIREMENTS – WINDOWS AND DOORS

THERMAL BREAKS

The window or door frame can greatly affect the energy efficiency of a wall-glazing system. As standard aluminium is a good conductor of heat and cold, a significant amount of heat can be lost through an aluminium frame. In general, this is why specific window systems comprised of less aluminium, such as fixed frames, have better thermal performance than systems that include more aluminium, such as sliding doors or awning windows.

The U-Value of a window or door system can be improved by adding a thermal break to the frame. Thermally broken window and door systems feature a reinforced polyamide strip within the aluminium frame, which creates an insulative barrier and reduces the levels of heat transfer from inside to outside and vice versa.

REDUCING THERMAL BRIDGING

In wall construction, thermal bridging is caused by materials of higher thermal conductivity, such as steel or timber framing, that penetrate surrounding insulation layers, creating a funnel of unobstructed heat flow through the wall area.[7] Insulation is used in wall systems to minimise heat transfer, but thermal bridging can undermine this by bypassing insulation layers thus enabling increased heat loss through the wall.[8]

Thermal bridging is addressed by NCC 2019, which requires wall performance calculations to be conducted in line with AS/NZS 4859.2:2018 Thermal insulation materials for buildings – Design. A wall's R-Value will be highly dependent on the extent of thermal bridging within the facade. Total System U-Values must also allow for the effects of thermal bridging.

Even a small amount of thermal bridging will significantly downgrade wall performance. The best performing walls will minimise thermal bridging, utilise continuous insulation and/or include thermal breaks.

WINDOW-TO-WALL RATIO

As the new Section J calculates wall and glazing performance as a combined facade element, the Window-to-Wall Ratio (WWR) and the performance of window and wall components relative to each other are key considerations for designers. The WWR of a facade refers to the amount of glazed area in relation to the amount of exterior wall area.

In general, walls will generally offer better U-Values than glazing systems. For example, a standard steel frame wall (non-thermally broken) has an approximate U-Value of 0.83. In comparison, the best performing thermally-broken, aluminium-framed windows with high performance glazing may offer a U-Value of approximately 1.7 to 2.0.

To improve a facade's thermal performance, designers can either reduce the glazing ratio or improve the performance of the lowest performing component. If poor performing windows are selected, design flexibility will be limited

PROJECT: The 2 Girls Building, VIC. ARCHITECT: Kavellaris Urban Design. BUILDER: Liberty Builders. FABRICATOR: Advanced Architectural Windows. PHOTOGRAPHER: Peter Clarke.

as only a small proportion of the facade can be made of glazing. For example, for an aged-care facility (Class 3) that requires a Total System U-Value of 1.1, if a non-thermally broken window with U-Value 3.9 is used in combination with a steel-framed, non-thermally broken wall with U-Value 0.83, approximately only 10% of the facade can be comprised of windows and doors.

The closer your glazing system performs to the required U-Value for the building class, the greater proportion of the facade can be comprised of glazing.

SOLAR HEAT GAINS AND SHADING

The SHGC requirements in the new Section J are particularly demanding on facade designs. For example, aged care facilities in Climate Zone 1 must have a SHGC of 0.07 for all aspects except the south aspect, which requires a SHGC of 0.10. Standard clear double-glazed windows have an approximate SHGC of 0.71. Even high performing windows, featured darkened low-emissivity glass, have a typical SHGC of approximately 0.16 – far above what is required for most building classes and climate zones.

As with Total System U-Value, addressing the WWR can help designers meet Section J's SHGC requirements. Poor performing window units will only be able to comprise a small percentage of a facade in most building classes as a greater wall ratio will be needed to compensate for the window unit's poor SHGC performance. Conversely, window units that offer better SHGC performance can take up a greater proportion of the facade.

Under the new Section J, shading has become a more important tool for reducing solar gains. Fixed or operable shading are acceptable, but they must operate automatically in response to the level of solar radiation. Other shading types include horizontal and vertical shading, screen shading, and balcony overhangs.

The extent of shading over the facade will determine its impact on SHGC. Typically, the length of the shading projection will correlate to reducing SHGC – the greater the shading projection over the window, the lower the SHGC value.

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Alspec products are supported by skilled staff committed to satisfying customer requirements. Consult with ESD consultants and Alspec early in the design phase to ensure your next project meets the elevated energy efficiency and sustainability requirements in the NCC 2019.

PROJECT: Quest Springfield Central, QLD
ARCHITECT: Deicke Richards
BUILDER: Kane Constructions
FABRICATOR: Inglass Pty Ltd

PROJECT: John Grey Hall of Residence, JCU, QLD. ARCHITECT: Wilson Architects.
BUILDER: ADCO Constructions. FABRICATOR: HPS Glazing.

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