

INSULATED SANDWICH PANELS & RESIDENTIAL ENERGY EFFICIENCY

Use of Insulated Sandwich Panels to simplify compliance with NCC 2022 Energy Efficiency requirements

ISPREE V05 - INDUSTRY 23



AUSTRALIAN STEEL INSTITUTE

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DOCUMENT PURPOSE

The National Construction Code sets the performance requirements for the construction industry to ensure that buildings are energy-efficient, resilient, and environmentally responsible. This is critical not only for the well-being of occupants but also for aligning with our collective sustainability objectives in Australia.

The purpose of this document is to provide guidance on utilising Insulated Sandwich Panels (ISP) to simplify compliance with the energy efficiency requirements and advance the transformation of Australia's built environment - a transformation essential for enhancing resilience and sustainability in the face of current and emerging challenges.



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NCC 2022 ENERGY EFFICIENCY

Volume One, Section J of the NCC underwent a significant transformation in 2019. However, Volume Two's energy efficiency provisions had remained unchanged since the introduction of 6-star ratings in 2010. NCC 2022 brought about substantial changes in energy efficiency and condensation regulations in Volume Two.

In 2022 the minimum star rating was raised to 7 stars, and there were also updates to the NatHERS climate files. This necessitated the recalibration of star bands to ensure consistency

between the two Deemed to Satisfy (DtS) pathways.

Furthermore, Whole-of-Home energy use was introduced for regulated appliances – which include heating and cooling equipment, hot water, lighting, and pool and spa pumps. For Class 1 structures, the NCC allocates an annual energy budget that covers 70% of energy consumption based on benchmark appliances, with the remaining 30% sourced from renewable energy.

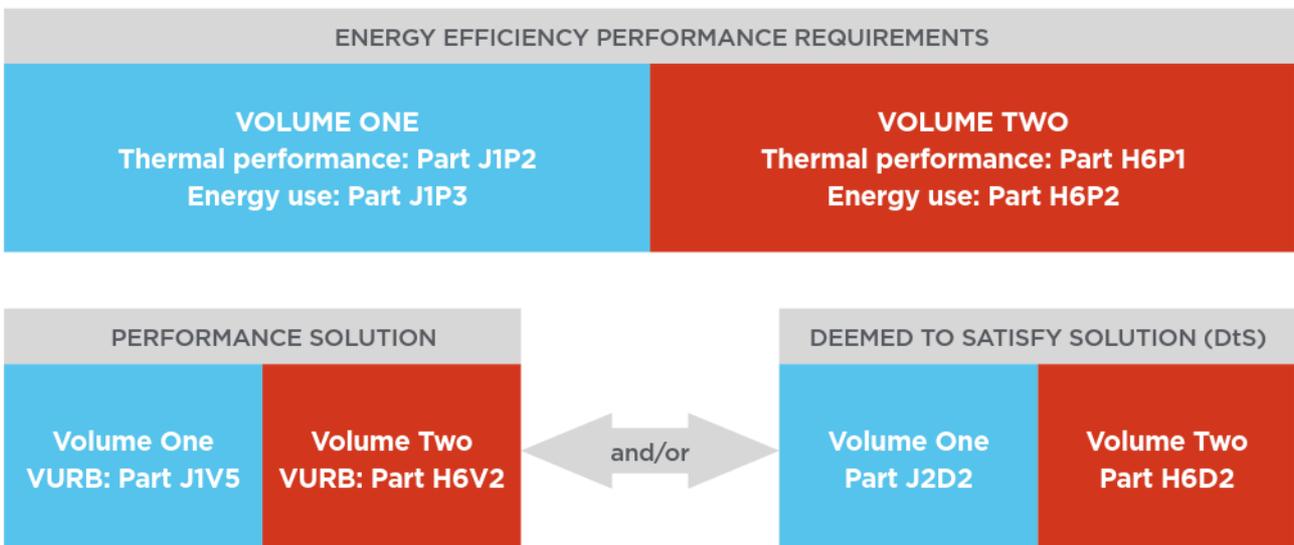
COMPLIANCE PATHWAYS

The National Construction Code is a performance-based code, providing a basis for the industry to explore new innovations, technologies, and novel materials. It aims to facilitate the construction of more practical, cost-effective, adaptable, and visually appealing buildings, all while upholding the safety, health, and comfort standards set by the Code.

To comply with the NCC, a building solution must meet the Performance Requirements, which are the mandatory requirements of the NCC.

Meeting the Performance Requirements can be accomplished through a Performance Solution, a Deemed-to-Satisfy Solution, or a combination of both. The Energy Efficiency Provisions for

NCC volumes One and Two are referenced below. The Energy Efficiency DtS solution offers two pathways, namely DtS elemental and DtS NatHERS.



BENEFITS OF INSULATED SANDWICH PANELS IN RESIDENTIAL APPLICATIONS

Insulated Sandwich Panels (ISP) are composed of two outer layers, predominantly made out of steel, sandwiching a layer of insulating core, such as PIR, EPS-FR or Mineral Wool. They are exceptionally energy efficient because of continuous insulation, thermally broken panel joints, and energy-efficient rigid insulating cores. As a result, ISPs help minimise energy consumption for heating and cooling, helping reduce associated carbon emissions, making them a smart choice for constructing energy-efficient buildings.

Insulated panel roofing and walling systems have gained significant popularity in residential applications due to their numerous benefits. They offer many advantages, however the key advantages in relation to energy efficiency, occupant's comfort, and environmental benefits are listed here:

Enhanced Energy Efficiency: Insulated Sandwich Panels offer exceptional thermal performance,

creating a highly effective thermal envelope for homes. They minimise heat transfer in both directions, helping keep interiors cooler in summer and warmer in winter. This leads to reduced heating and cooling costs, contributing to long-term energy savings for homeowners.

Improved Comfort: Homes built with ISP roofing and walling can maintain more comfortable indoor temperatures throughout the year with minimum temperature fluctuations, creating a more pleasant living environment for residents.

Environmental Benefits: Quick installation times, which minimises the environmental impact on the construction site, durability and minimal maintenance, as well as reduced energy consumption throughout the life of the building, help lower the carbon footprint of residential buildings constructed using Insulated Sandwich Panel.

TYPES OF CORE MATERIALS COMMONLY USED IN INSULATED SANDWICH PANELS

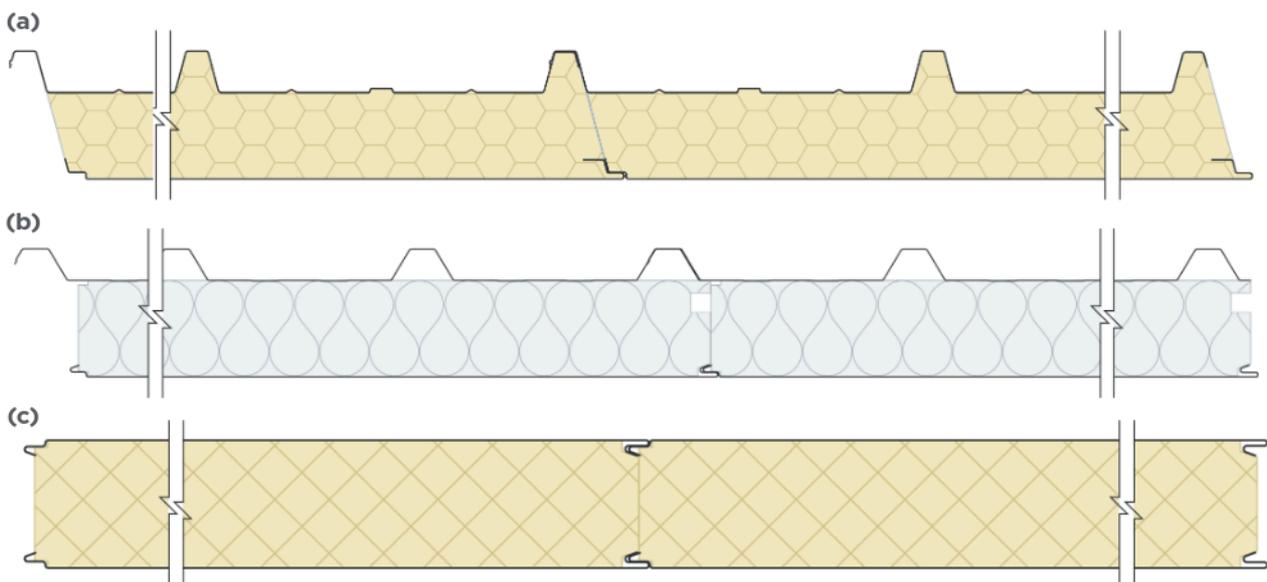
(a) Polyisocyanurate (PIR)



(b) Expanded Polystyrene with Flame Retardant (EPS-FR)



(c) Mineral Wool (MW)



INSULATED SANDWICH PANELS AND NCC 2022 ENERGY EFFICIENCY

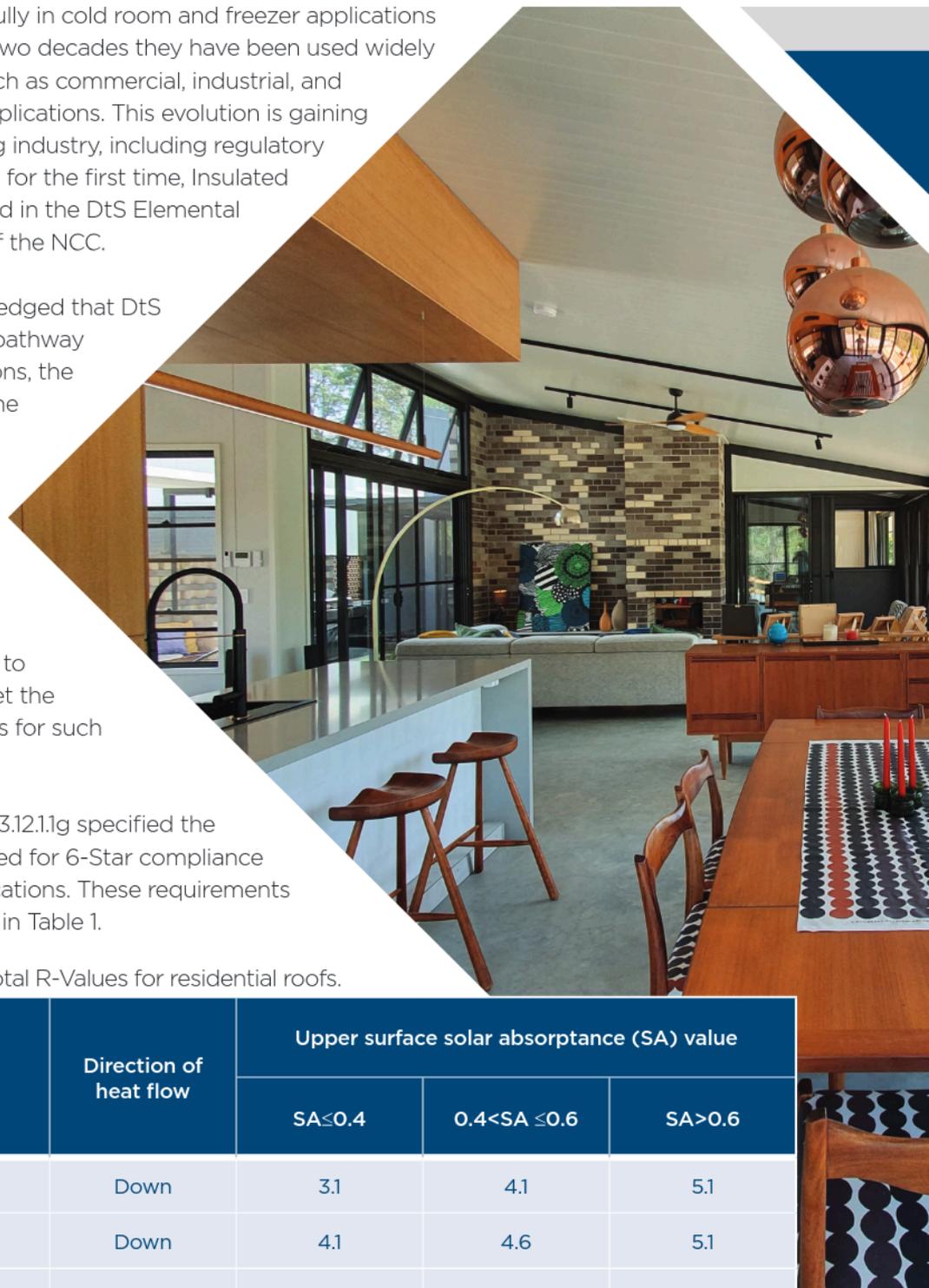
ISPs have been used successfully in cold room and freezer applications for many years. Over the last two decades they have been used widely in other building segments such as commercial, industrial, and more recently in residential applications. This evolution is gaining recognition across the building industry, including regulatory bodies. Consequently, in 2022, for the first time, Insulated Sandwich Panels were included in the DtS Elemental energy efficiency provisions of the NCC.

While it is commonly acknowledged that DtS NatHERS is the predominant pathway utilised in residential applications, the following example illustrates the elemental pathway. Unlike the NatHERS approach, which sometimes obscures individual impacts through trade-offs between building elements, the elemental pathway is employed here to pinpoint specific changes and to demonstrate how ISP can meet the energy efficiency requirements for such applications.

In NCC 2019, Tables 3.12.1.1a to 3.12.1.1g specified the minimum Total R-Values needed for 6-Star compliance for roofing in residential applications. These requirements have been summarised below in Table 1.

Table 1: NCC 2019 minimum Total R-Values for residential roofs.

Climate Zone	Altitude	Direction of heat flow	Upper surface solar absorptance (SA) value		
			SA≤0.4	0.4<SA ≤0.6	SA>0.6
1		Down	3.1	4.1	5.1
2	< 300	Down	4.1	4.6	5.1
2	≥ 300	Down & Up	4.1	4.6	5.1
3		Down & Up	4.1	4.6	5.1
4 & 5		Up	4.1	4.6	5.1
6 & 7		Up	4.6	5.1	5.1
8		Up	6.3	6.3	6.3



NCC 2022 elemental tables aim to raise the standard from 6 to 7 stars and include a wider range of tables to ensure a consistent outcome for all compliance pathways. The inclusion of tables 13.2.3x in Volume Two Housing Provisions and J3D7x in Volume One is a recognition of the growing popularity of ISP roofing products, and facilitates the thermal design of ISP roofing systems.

Table 2: Total R-Value for roofs constructed with insulated sandwich panels.
(Housing Provisions Table 13.2.3x and Volume One Table J3D7x)

Climate Zone	SA ≤ 0.6	0.23 < SA ≤ 0.32	0.32 < SA ≤ 0.42	0.42 < SA ≤ 0.53	0.53 < SA ≤ 0.64	0.64 < SA ≤ 0.73	0.73 < SA ≤ 0.85	0.85 < SA ≤ 0.96
1 (Single storey dwelling)	1.40	3.31	x	x	x	x	x	x
1 (Two or more storey dwelling)	1.86	3.31	4.32	x	x	x	x	x
2 (Heat flow down)	3.11	3.11	3.31	3.66	3.66	x	x	x
2 (Heat flow up)	3.02	3.02	3.22	3.57	3.57	x	x	x
3 (Heat flow down)	3.31	3.66	4.32	x	x	x	x	x
3 (Heat flow up)	3.22	3.57	4.22	x	x	x	x	x
4	3.22	3.22	3.22	3.22	3.22	x	x	x
5	3.02	3.02	3.02	3.02	3.02	x	x	x
6	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57
7	4.22	3.90	3.90	3.57	3.57	3.22	3.22	3.22
8	3.90	3.57	3.57	3.22	3.22	3.02	3.02	3.02

Comparing the above tables and translating the Total R-Values into panel thickness, demonstrates that under NCC 2022 use of ISP can result in **reductions of panel thickness of 10 to 40% to achieve the required R-Value.**

ISP roofing is an all-in-one system comprising the external cladding, insulation, and internal ceiling, while its impressive spanning capabilities reduces the need for intermediate support structures. This leads to a thinner roof/ceiling system compared to conventional methods. In alignment with NCC 2022, Tables 13.2.3x and J3D7x will further reduce panel thickness to meet the energy efficiency requirements. Table 3 illustrates examples of ISP roofs designed under NCC 2019 compared with NCC 2022 in different Australian Climate Zones.

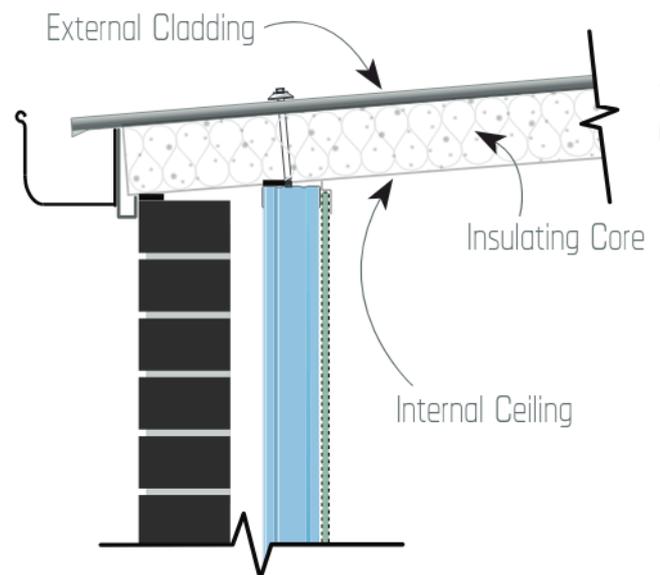


Table 3: Comparison of ISP roof designed to NCC 2019 and NCC 2022.

Climate Zone		1	2	5	6
Location		Darwin Cairns	Brisbane Mackay	Adelaide Perth Sydney	Melbourne Albany
Altitude		n/a	<300	n/a	n/a
Direction of heat flow		Down	Down	Up	Up
Upper surface Solar Absortance		$SA \leq 0.23$	$0.42 < SA \leq 0.64$	$0.42 < SA \leq 0.64$	$0.42 < SA \leq 0.64$
NCC 2019 (6 Stars)	Min. Total R-Value	3.1	4.6	4.6	5.1
	Min. ISP thickness EPS-FR (mm)	125	200	200	200
NCC 2022 (7 Stars)	Min. Total R-Value	1.4*	3.66	3.02	3.57
	Min. ISP thickness EPS-FR (mm)	75	150	125	150
Reduction in panel thickness		40%	25%	38%	25%

*Single storey dwelling

CONDENSATION MANAGEMENT

Another aspect closely tied to energy efficiency is condensation management. As buildings become more airtight and energy-efficient, the risk of condensation also increases. Therefore, proper design and detailing becomes even more crucial. NCC 2022 introduces certain requirements to address the potential for condensation, including minimum roof space ventilation.

It is worth noting that NCC 2022 Housing Provisions 10.8.3(2)(b) and Volume One clause F8D5(2)(b) **exempt roofs constructed with ISP from roof space ventilation requirements**, as ISP roofs reduce the likelihood of condensation. For further information regarding roof space ventilation requirements, please refer to other ASI documents in this series.

THERMAL BRIDGING MITIGATIONS

Thermal bridging refers to the heat transfer that occurs through a material or structure that conducts heat more effectively than the surrounding insulation. This issue becomes more significant as the temperature difference between the inside and outside of the building increases. NCC 2022 includes provisions for mitigating thermal bridging in residential applications. Insulated Sandwich Panels, originally used in cold room and freezer applications with extreme temperature differentials, are inherently designed to reduce thermal bridging. They achieve this through a continuous and rigid insulation layer, and an airtight and thermally

broken panel joint. **NCC 2022 acknowledges this, exempting ISP roofs from thermal bridging mitigations. Housing Provisions 13.2.3(8), and Volume One clause J3D5(2) state the thermal bridging exemptions for ISP roofing. ISP walls thermal bridging exemption can be found in Housing Provisions 13.2.5(6), and Volume One clause J3D6(2).**

It is important to note that the insulating core must comply with AS/NZS 4859.1:2018 and the Total R-Value of the ISP as a whole must be determined in accordance with AS/NZS 4859.2:2018.

SUMMARY

NCC 2022 brings significant enhancements for the use of ISPs in residential applications in both Volumes.

The introduction of dedicated tables for ISP roofing makes it easier for designers and builders to achieve compliance with energy efficiency requirements. Furthermore, the exemption from thermal bridging and condensation mitigations recognises the inherent thermal performance of Insulated Sandwich Panels and streamlines the construction process.

In summary, insulated panel roofing and walling systems offer a comprehensive package of benefits for residential applications. They can improve energy efficiency, enhance comfort, and provide durability. These, together with structural integrity and ease of installation, makes Insulated Sandwich Panels a compelling choice for the building envelope.





NASH is an Australian industry association representing the interests of fabricators, material suppliers and customers of cold-formed steel structural framing systems for residential and similar construction. NASH develops Standards, Handbooks and Technical Notes for use by the industry and NASH Standards are referenced as Deemed-to-Satisfy solutions in the National Construction Code.

Contact NASH: +61 3 9809 1333
info@nash.asn.au
visit: www.nash.asn.au



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Contact ASI: +61 2 8748 0180
enquiries@steel.org.au
visit: www.steel.org.au.

