CONDENSATION AND MOISTURE MANAGEMENT WITHIN RAINSCREEN SYSTEMS

Learn the critical importance of condensation and moisture control in creating healthy buildings and discover effective methods to ensure long-term durability through cavity system management.

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INTRODUCTION

In Australian commercial building design, managing condensation has become increasingly critical with the rise of stringent energy efficiency standards and global climate commitments.

Condensation management in Australia is complex due to the diverse climatic conditions and evolving building practices, including:

- Increased airtightness: Modern standards emphasise airtightness to improve energy efficiency. While this reduces energy loss, it can trap moisture if not properly managed. A 2012 study, reported by the Department of the Environment and Efficiency in 2016, indicated that updated building practices, driven by National Construction Code (NCC) amendments, could potentially cut energy consumption by up to 53%.
- Insufficient ventilation: Enhanced airtightness can reduce natural ventilation, leading to higher indoor humidity and increased condensation risks. Australian buildings have historically relied on passive ventilation to manage internally generated moisture. The relatively milder climate allowed for this to continue in contrast to global trends.
- Climatic variations: Australia's climate ranges from tropical to alpine, each presenting unique challenges for condensation management. For instance, the most populated South-East regions (Zones 5-8) are particularly prone to issues of trapped internal vapour.
- Building materials and design: Inappropriate material choices in wall sarking for the area and ineffective rainscreen design can exacerbate condensation problems.

Park Sydney, Erskineville NSW

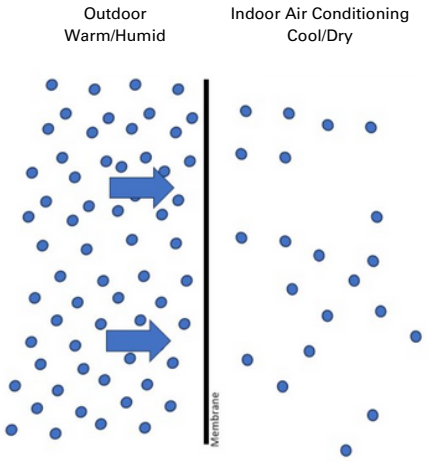
Wall sarking, a vital component of the rainscreen system, serves as the primary barrier against external, weather-related moisture infiltration. It prevents any moisture that penetrates the cladding layer from reaching the building envelope. Additionally, these water barrier membranes reduce pressure-induced airflows between the interior and exterior environments, enhancing the building's overall airtightness.

Specifying sarking is not a one-size-fits-all process and it is important to consider the direction and intensity of vapour flows within the specific area. In regions with high humidity the goal is to reduce the external humidity from entering the building, which can be achieved with lower vapour permeable sarking. While for cooler climates, it's all about letting internal moisture escape, which often requires higher vapour permeability.

The vast expanse of the Australian continent features a diverse range of microclimates, from the tropical north to the alpine regions of Victoria. To simplify classification, the National Construction Code (NCC) employs a Climate Zone Map that groups similar regions together in order to assign minimum vapour permeability requirements to each. As industry understanding has advanced, it has become clear that making buildings airtight can lead to varying outcomes based on their location and the direction of water vapour flow.

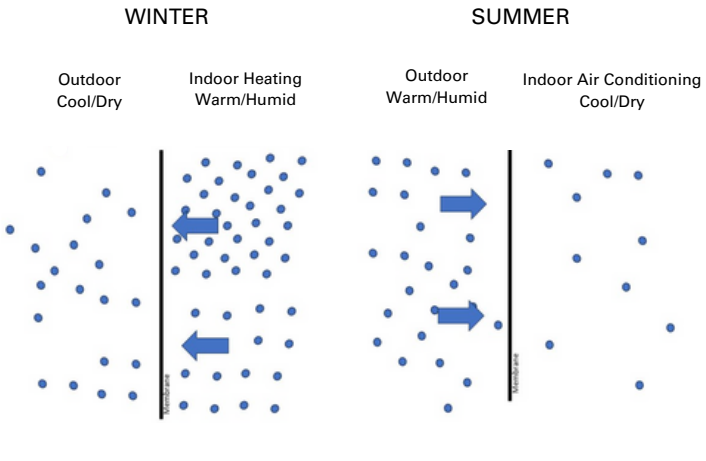
Sarking is one element of the overall rainscreen cavity system that helps to fight condensation, however the rainscreen system design plays a crucial role in effectively venting out moisture that exits the building envelope. Ensuring the cavity design optimises airflow and circulation is critical in the overall fight against moisture damage.

Typical conditions found across tropical parts of Australia



Need to keep moisture out of the building envelope

Typical conditions found across South-East parts of Australia



Need to vacate moisture during cool climatic intervals

Need to reintroduce some moisture during hot climatic intervals (when air conditioning is used)

Selecting the right sarking is important to ensure the adequate management of moisture movement in and out of the building.

Australian Climate Zone Map - Climate Zone 1 and 7
Source: YourHome website (https://www.yourhome.gov.au/)

CONDENSATION IN BUILDINGS

The first "Condensation in Buildings" handbook was developed by the Australian Institute of Architects (AIA) and published by the Australian Building Codes Board (ABCB) in 2011. This handbook acknowledged condensation as an emerging challenge with the potential to significantly impact both the health of building structures and the wellbeing of their occupants.

To appreciate the seriousness of this issue, it's important to recognise some key properties of vapour and the main drivers determining it's flows:

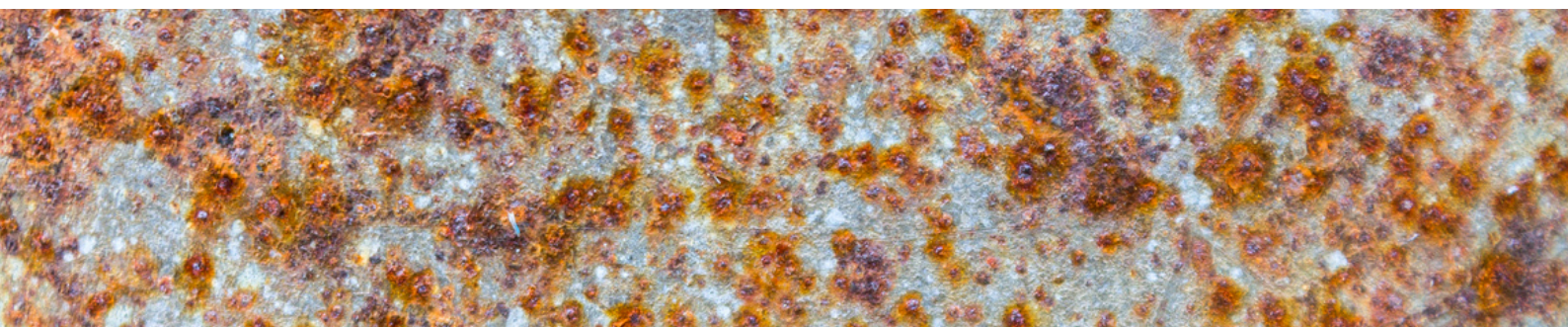
- Water vapour molecules are smaller than water droplets and can easily penetrate wall linings, migrating into cavities where they may condense into liquid form. This ability for water vapour to infiltrate and potentially cause hidden damage underscores the difficulty in detecting and addressing condensation problems before they lead to significant structural issues.

If left unaddressed, condensation issues can lead to several serious problems:

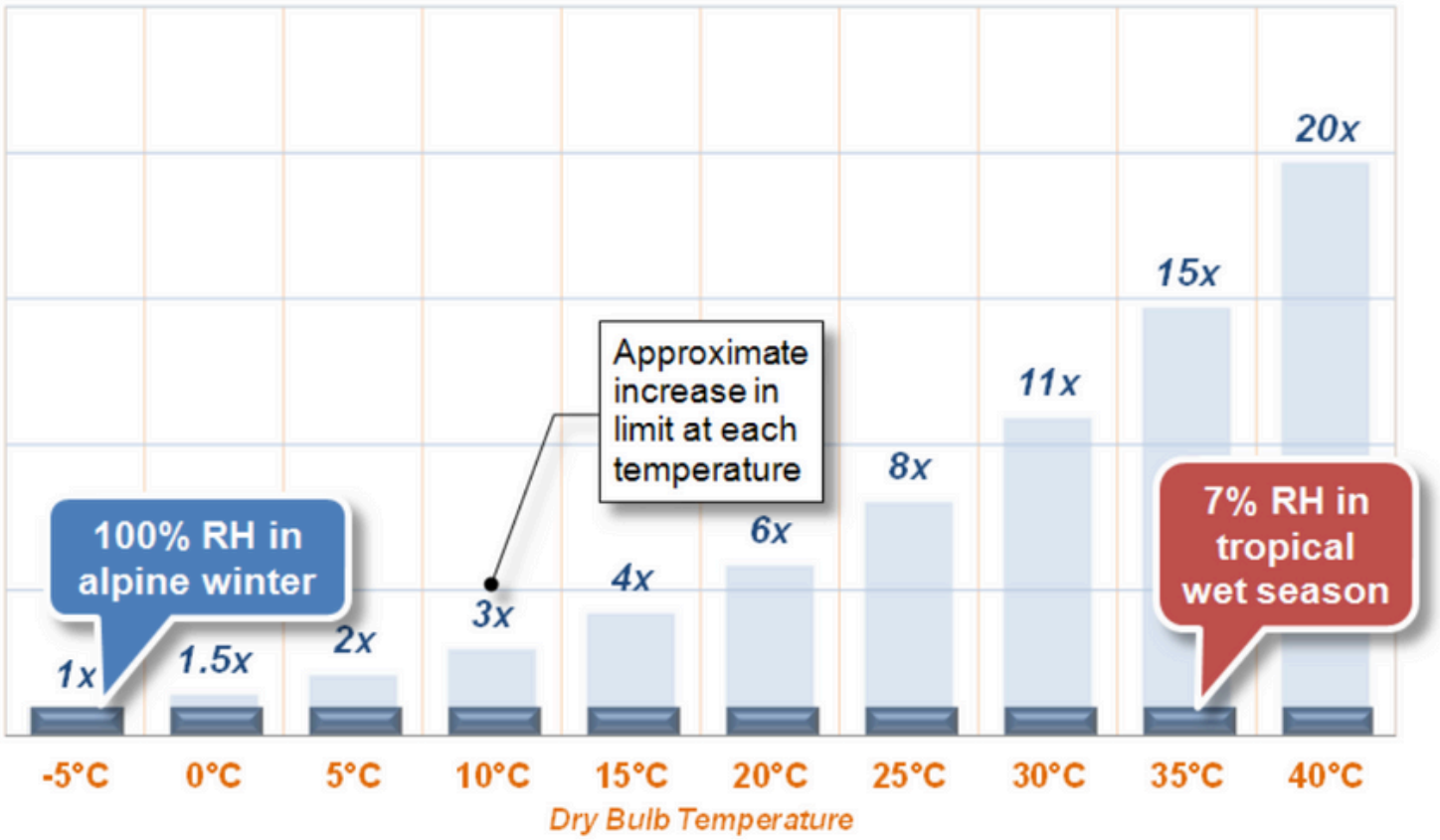
- Mould growth: Mould thrives in damp environments and has been linked to a range of health issues, including respiratory problems such as nasal congestion, asthma, allergies and weakened immune systems. Additionally, mould can damage internal linings and cause unsightly stains.
- Structural corrosion: Moisture can cause steel framing to corrode, potentially leading to structural failure or incurring substantial remediation costs.

Concepts and principles related to condensation:

- Moisture capacity: Warm air can hold more moisture than cool air. Therefore, when warm, moist air encounters cooler surfaces, it is more likely to condense.
- Dew point: The dew point is the temperature at which the relative humidity (RH) of the air reaches 100%. At this point, the air can no longer retain moisture in its vapor form, leading to condensation as the vapor turns into liquid.
- Thermodynamic principles: According to the laws of thermodynamics, when there is a temperature difference between two environments (such as indoor and outdoor), energy will flow from the hotter environment to the cooler one in an attempt to achieve equilibrium, taking water vapour with it.
- Relative humidity: Relative humidity is the amount of water vapor present in the air compared to the maximum amount of vapor the air can hold at a specific temperature and pressure. It is a key factor in predicting condensation.
- Convective currents and rainscreen systems: Warm, moist air rises and creates convective currents by drawing in cooler air from below. Rainscreen systems leverage this principle to manage moisture and regulate temperature by allowing for proper ventilation and moisture control within the cavity.



Understanding these principles is essential for effective condensation management in building design and construction.



Source: ABCB "Condensation in Buildings" Report 2019.

This table shows the approximate increases in water vapour limits rising with temperature. When the amount of water vapour is fixed, RH falls as the temperature rises.

NCC CHANGES

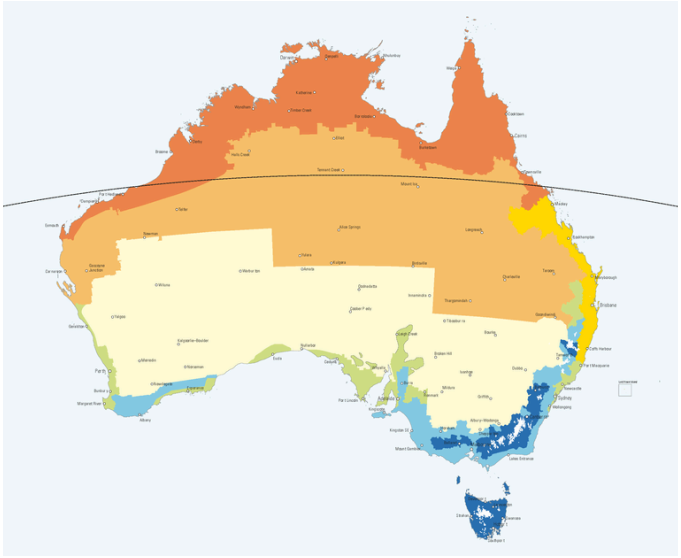
The initial introduction of the 'Condensation Management' section in NCC 2019 referenced Australian Climate Zones. DtS Clause 3.8.7.2 Part (a) pertained specifically to condensation management for residential buildings and stated; where a pliable membrane is used in Climate Zones 6-8, it must be vapour permeable. Non-water barriers, such as perforated foil membranes, were permitted on projects with a drained cavity (rainscreen system). Although perforated foil membranes are still in use today, they may not satisfy the weatherproofing requirements set by cladding suppliers. Consequently, they should not be employed in situations where they will remain exposed on an unclad structure.

NCC 2022 has refined the classification for pliable membranes by introducing specific quantifiable measures for vapour permeability. Under the updated DtS provisions, membranes used in Climate Zones 4-8 must conform to AS 4200.1 for vapour permeability and be installed according to AS 4200.2.

CLIMATE ZONE	VAPOUR PERMEANCE OF NOT LESS THAN µg/N.s	MEMBRANE CLASS
4-5	0.1430	3
6-8	1.1400	4

Source: ABCB website (https://abcb.gov.au)

Additionally, the membrane must be positioned on the external side of the primary insulation layer. The classification of pliable membranes is now based on their vapour permeability score, as tested in accordance with AS 4200.1.



Australian Climate Zone Map
Source: Australian Building Codes Board

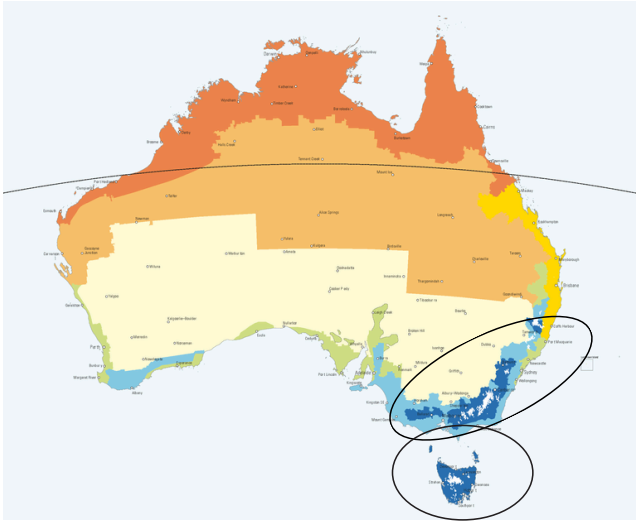
The Climatic Zones 1-8, range from the tropical areas found in North Queensland, to the alpine areas of the Southern Alps.

- Climate zone 1 – High humidity summer, warm winter
- Climate zone 2 – Warm humid summer, mild winter
- Climate zone 3 – Hot dry summer, warm winter
- Climate zone 4 – Hot dry summer, cool winter
- Climate zone 5 – Warm temperate
- Climate zone 6 – Mild temperate
- Climate zone 7 – Cool temperate
- Climate zone 8 – Alpine

For high humidity regions defined as Zone 1, where regular vapour flows from the outside in are common, a vapour barrier can be particularly beneficial. Conversely, in cooler climates where internally heated, moisture-laden air presents a significant condensation risk, and a vapour permeable membrane is essential for removing moisture from the structure.

The most populated parts of Australia, including Victoria and New South Wales, experience mild to cool temperatures during winter and are classified as Zones 6 and 7. For these areas, the NCC 2022 mandates a Class 4 vapour permeable membrane with a minimum vapour permeability of 1.140 µg/N.s. Similarly, Zones 4 and 5, which also experience cool winters, require at least a Class 3 vapour membrane with a minimum permeability of 0.143 µg/N.s., although a Class 4 membrane can also be used.

The alternative, performance-based verification method, which is not covered here, now includes specifically defined targets for reducing condensation risk. Both the DtS and Performance Solution methods can be used together to achieve compliance.



Australian Climate Zone Map
Source: Australian Building Codes Board

Most populated areas within Australia are found in Zone 6 & 7.

These changes, which took effect on October 1st, 2023, rendered many commonly used membranes non-compliant with the new DtS provisions due to their insufficient vapour permeability.

Fairview's Vitrafix Wall Sarking and Vitrafix Wall Sarking Ultra meet the Class 4 vapour permeability requirements and exceed the Building Code's mandates. Both products are suitable for use in applications requiring either Class 3 or Class 4 membranes.

It is important to note that moisture issues within a structure can also arise from improper membrane installation or extended exposure to UV weathering, particularly if the building remains unclad for extended periods. The Vitrafix range is designed to address these concerns, offering superior UV resistance and material strength while being easy to install.

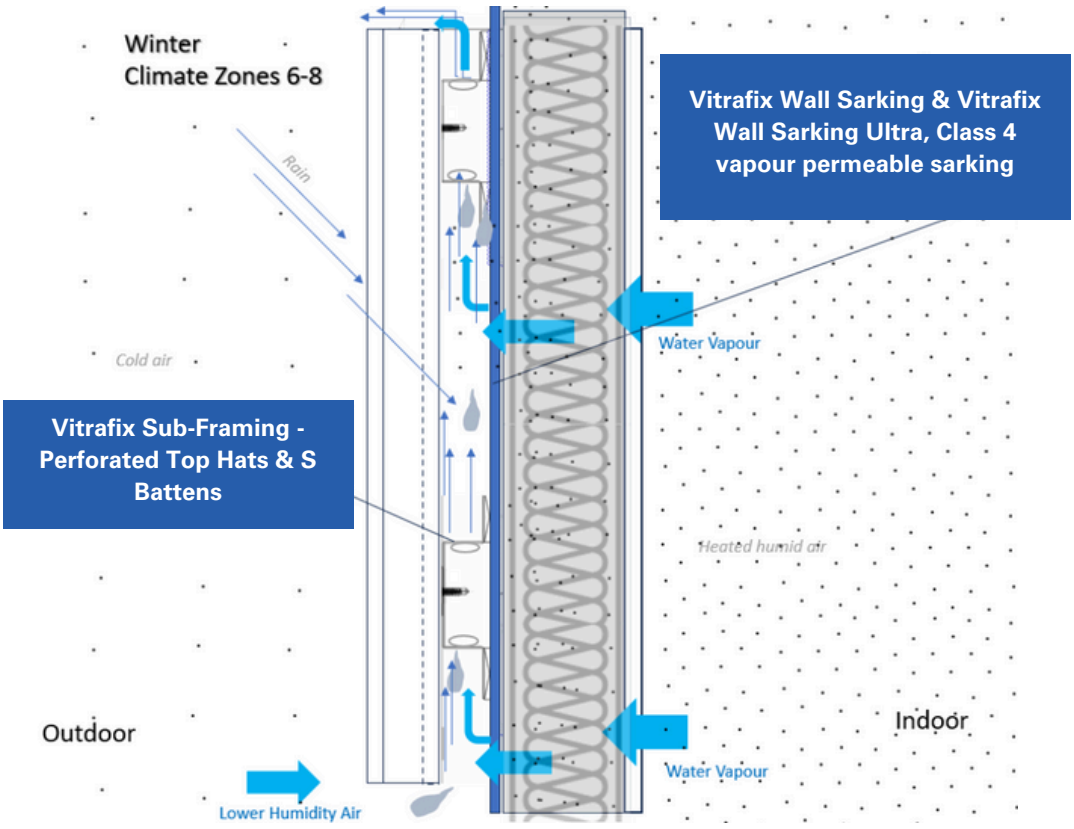
In Climate Zones 4-8, internal heating is often necessary to maintain comfortable indoor temperatures. This creates a thermal imbalance with the external environment, causing warm, vapour-laden air to migrate towards the cooler outside.

In Class 2, 3 and 4 buildings, significant moisture is typically generated from activities such as drying clothes, cooking, showering and respiration. This moisture becomes water vapour in the heated air. Without effective ventilation, this moisture can spread throughout the building, penetrating internal linings. It either exits through the membrane into the rainscreen cavity or condenses when it contacts sufficiently cold surfaces, typically when the vapour is cooled below its dew point.

Condensation often occurs in the cooler parts of the wall assembly, beyond the main insulation layer, and on the inner side of the external sarking if it is not sufficiently vapour permeable. Additionally, vapour can condense at locations with heat loss due to thermal bridging, such as through metal brackets.

To address these issues, a Class 4 vapour permeable membrane is recommended. This type of membrane offers adequate permeability to manage moisture effectively, allowing vapour to flow through the membrane due to the pressure differential between the interior and exterior environments.

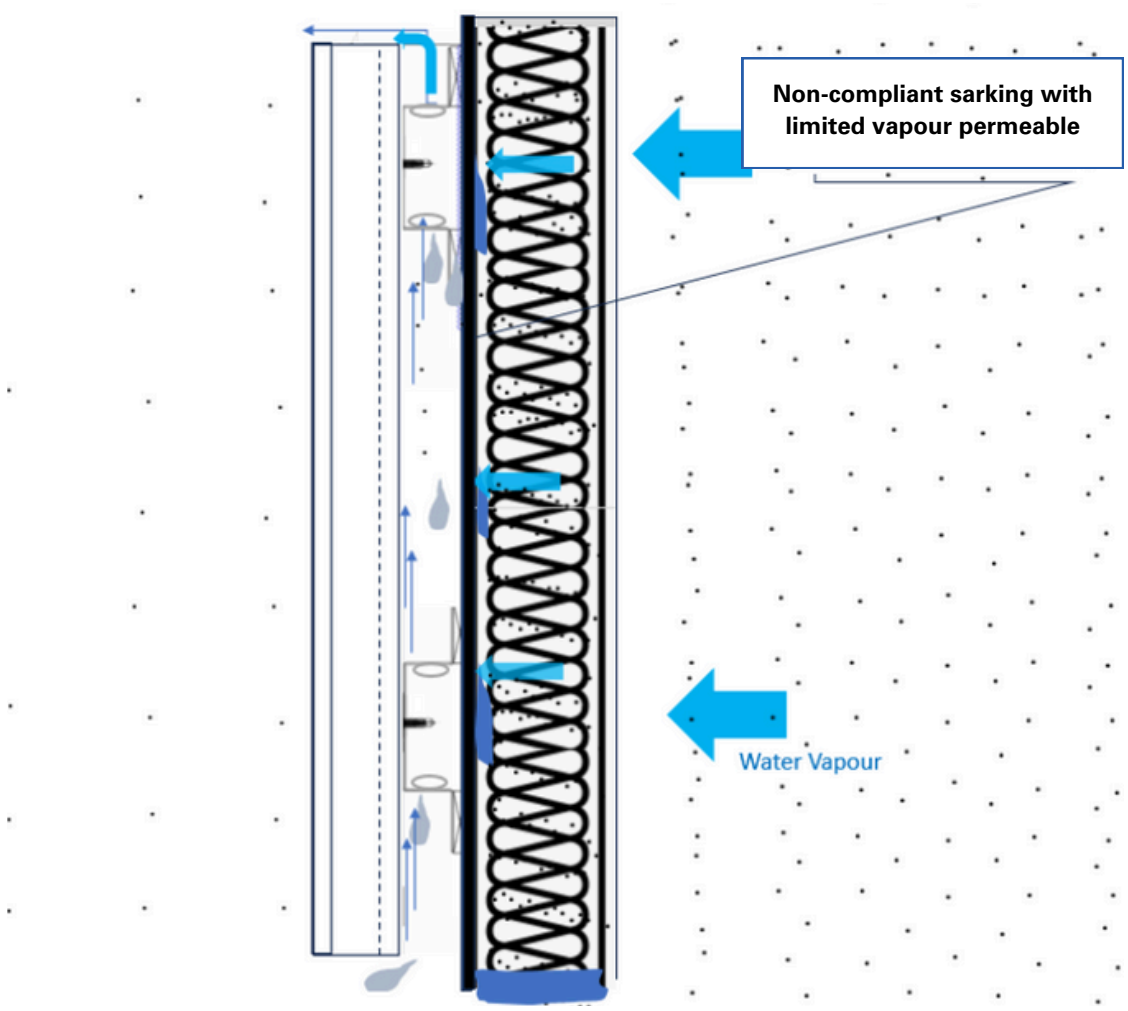
Water vapour escaping into the rainscreen cavity



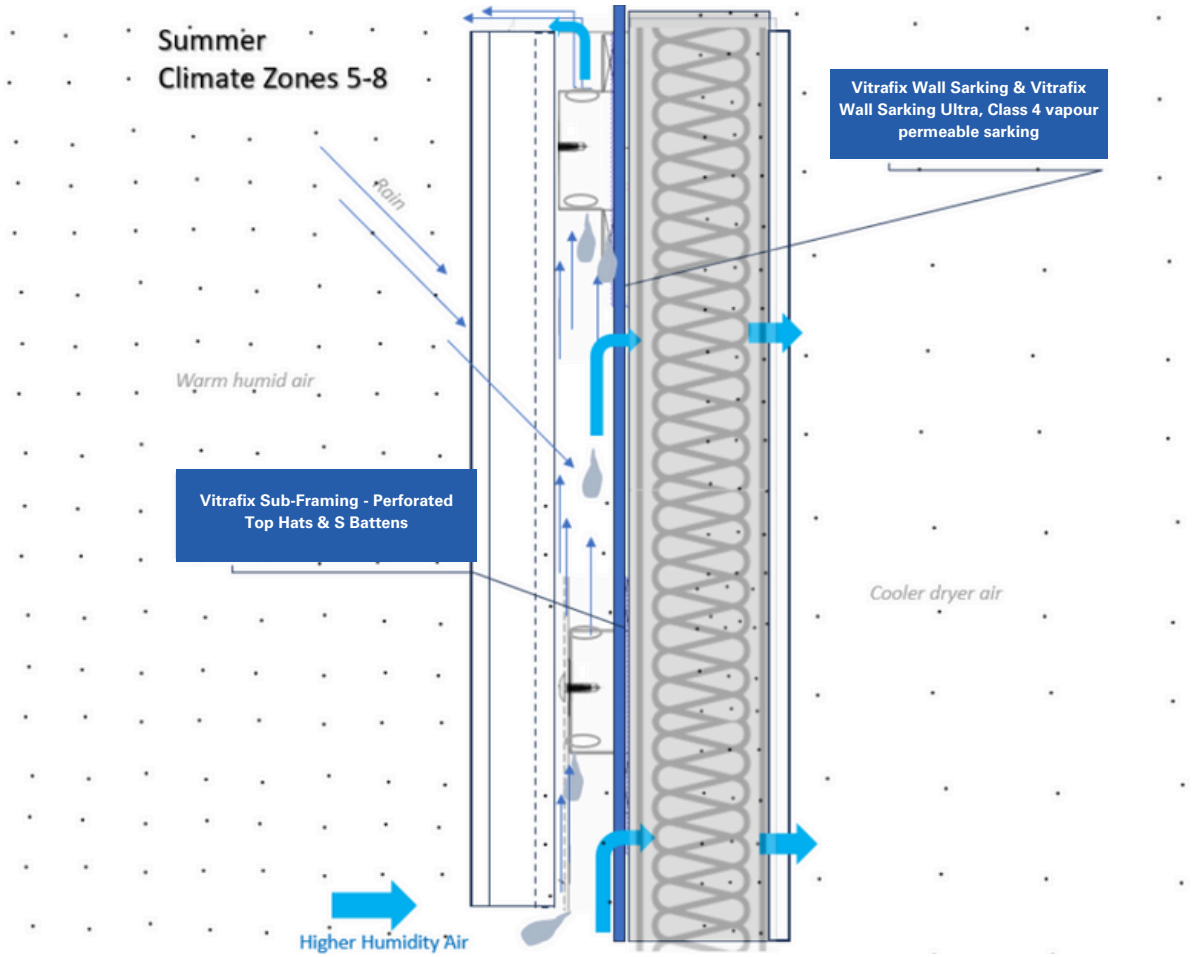
Once moisture passes through the wall, it enters the cavity between the sarking and facade. If this moisture is not removed, it poses a health risk to the building and most current sub-framing does not allow for proper venting of the cavity.

Installing a membrane with inadequate vapour permeability or using vapour barriers, can trap moisture within the building structure. As a result, this trapped moisture can remain hidden and cause ongoing damage, potentially leading to significant structural issues over time.

Restricted water vapour unable to escape



Conversely, for Zones 5-8 during the summer, the outside environment will now contain more moisture and the higher pressure will mean moisture is absorbed and will migrate inside the building, provided a vapour permeable membrane is used. The internal linings are also predominantly vapour permeable, allowing the moisture to penetrate through. The increased moisture content can have a positive effect on the indoor environment, as dry air-conditioned air has been proven to carry bacteria and viruses. Humidity and its Effect on the Viability and Transmission of Respiratory Viruses by Smith, J. D., Johnson, M. and Lee, A. in Journal of Virology Research, 2023, highlights that lower humidity levels generally enhance the survival of respiratory viruses.



It's important to recognise that variations in humidity and temperature occur across all Climate Zones, and each zone can experience fluctuating vapor flows and intensities throughout the day, night and different weather patterns.

Currently, there are no specific vapor permeability requirements for Climate Zones 1-3. For instance, in Zone 1, which experiences high summer humidity, installing a vapor barrier may be beneficial to prevent moisture from entering the building. This approach helps manage the impact of external humidity and ensures the building's internal environment remains controlled and protected.

RAINSCREEN SYSTEMS

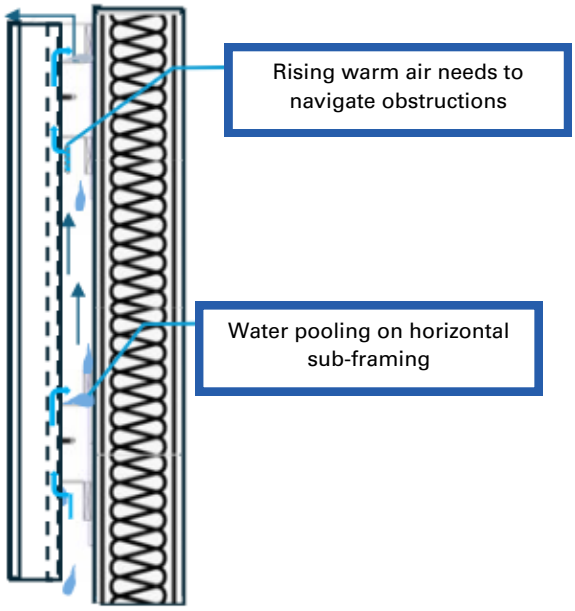
The rainscreen cavity effectively manages moisture by utilising passive methods such as convective circulation (the chimney effect) and gravitational drainage. When combined with vapor-permeable membranes, the rainscreen system helps expel moisture from the building.

To maximise effectiveness, the system must include ventilation openings at both the top and bottom of the cavity, as well as drainage pathways to address potential water pooling, such as at the base of external vertical soffit corners.

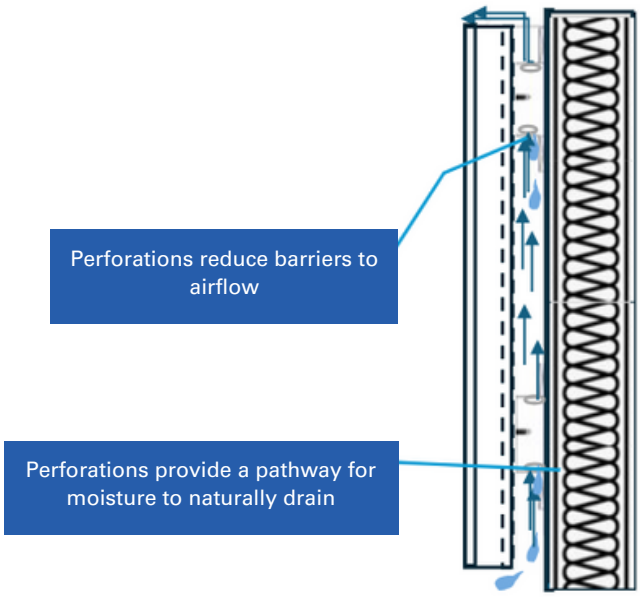
Optimal airflow within the cavity is crucial for enhancing drying efficiency. However, traditional sub-framing components, like top hats, can impede airflow and drainage, particularly when oriented horizontally, reducing the system's overall drying effectiveness.

To address these challenges, Fairview has developed a range of Vitrafix perforated sub-framing products designed to improve airflow and promote effective cavity drainage. The Vitrafix perforated Top Hat and S Batten range offer a passive solution to prevent moisture buildup and are engineered for structural integrity, as confirmed by the company's standard façade span tables. These products are versatile and suitable for use in various façade systems where enhanced airflow and drainage are required.

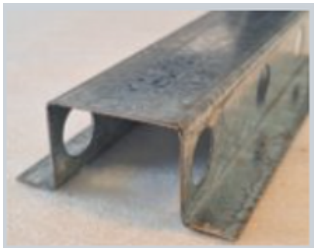
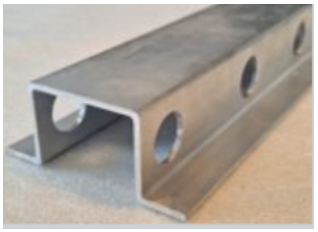
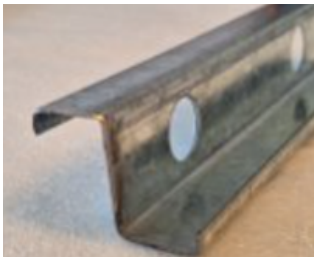
Traditional top hats create an obstacle for air flow and moisture drainage.



New Vitrafix Perforated Top Hats overcome the problem, creating air/moisture pathways through the top hat



VITRAFIX SUB-FRAMING RANGE

PERFORATED STEEL TOP HAT 24MM	
PERFORATED STEEL TOP HAT 35MM	
PERFORATED ALUMINIUM TOP HAT 24MM	
PERFORATED ALUMINIUM TOP HAT 35MM	
PERFORATED STEEL S BATTEN 35MM	

Learn more about the Vitrafix range of façade accessories here.

Fairview's moisture management solutions, including Vitrafix Perforated Top Hats and S Battens, combined with NCC-compliant sarking products, provide a comprehensive system designed to effectively manage moisture and maintain a dry cavity. This approach ensures adherence to regulations and enhances overall building performance.

vitrafix™

FAÇADE SYSTEM ACCESSORIES / BY FAIRVIEW

SUMMARY

The increasing challenges of condensation in Australian building design necessitate a nuanced understanding of both regulatory requirements and climatic conditions. The NCC's updated provisions on vapour permeability and the role of Rainscreen Systems underscore the importance of effective moisture management. By adopting appropriate materials and design strategies, including the latest advancements in sub-framing and sarking products, architects and engineers can mitigate condensation risks and enhance building performance in diverse Australian climates.

FAIRVIEW

Supported by a team of driven, innovative and collaborative professionals, Fairview is committed to providing aesthetically pleasing and compliant cladding panels for the construction industry. With almost 30 years' experience in the façade industry, Fairview is dedicated to consistently facilitating the successful delivery of innovative facades that meet the requirements and vision of each project.

With one of the largest stock holds in Australia, Fairview have the ability to ensure a consistent and timely supply to our dedicated installer network. The company's flexible and innovative approach allows us to work closely with our clients to deliver the best possible project outcomes.

WEATHERPROOF AND COMPLIANT

Fairview supply cladding products and façade system accessories that demonstrate proven performance, energy efficiency and minimal maintenance – products that are built for the future. Importantly, Fairview cladding products meet the requirements of AS4284, with test results demonstrating industry-leading performance. Test results are readily available for analysis of both serviceable and ultimate wind load pressures.

Under independent testing in NATA-approved testing laboratories, Fairview products, namely Stryüm, Vitracore G2 and Vitradual, exceeded the minimum testing requirements and outperformed its key competitors. Waterproof testing, which measures the cladding system's ability to prevent leakages under skyscraper-high wind pressures, proved that Fairview products performed above and beyond the 2.5kPA performance target set out in Verification Method of the NCC.

Fairview's innovation and technical teams have delivered solutions that significantly exceed Building Code requirements, giving project stakeholders peace of mind. Fairview products are also rigorously tested to meet fire performance requirements, with exceptional durability, longevity and sustainability values.

Available in a range of profiles and customisable options, Fairview cladding combines its reliable and proven performance with limitless design flexibility to deliver modern sustainable cladding solutions ideal for Australian buildings.

AUGUST 2024

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