Fact sheet

October 2024

Research Insights: Management of Condensation and Mould Growth Risk

Q&A

The following answers have been provided to questions asked during the Research Insights: Management of Condensation and Mould Growth Risk on 19 September 2024.

*The answers provided are correct as of **3 October 2024**.*

Where can I find a copy of the presentation slides?

A copy of the presentation slides and recording of the webinar are available from the VBA website.

How do the following construction techniques, materials, and design contribute to enhancing moisture control and proper ventilation in building structures:

a) ventilated drainage space and membrane for cladding (walls and roof)

b) bring up the floor slab membrane around the slab edge to connect the wall drainage plane

a) Firstly, drainage space creates a gap between the structural wall component and external cladding. When water penetrates the outer cladding layer, it drains through the gap preventing moisture being trapped and seeping into the structural elements of the building. This separation helps break any capillary action that can draw moisture past the gap to the structural building components

Secondly, the membrane is a moisture barrier that prevents water from reaching the inner structural wall components. Typically, it may be breathable to allow water vapour to escape but prevents liquid water from entering this layer.

b) Bringing the floor slab membrane around the slab to connect to the wall drainage plane may provide continuous moisture barrier for the slab and external wall of the building which protects a critical junction managing and minimising the opportunity for water ingress occurring. The effectiveness of the method primarily prevents capillary action, which would be drawing water up the slab membrane, to the vertical structure. The minimum design and construction technical requirements for this junction can be found in *National Construction Code (NCC) Volume Two Part 4.2.8.*

What should be the size of the batten and minimum gap behind a timber cladding batten to create a ventilated cavity?

Will cladding that is battened out really prevent condensation any better than direct fixing to the frame if the correct vapour barrier is used?

What dimension of cavity is suggested for external cladding such as cement weatherboards?

Are there dimensions in the Building Code of Australia (BCA) or NCC that the wall cavity should be for the installation of external cladding for the membrane?

The NCC provides details and requirements for cavity construction (incl. depth) specific to masonry and masonry veneers walls in Volume Two Part 5. The details for timber wall cladding and sheet wall cladding (fibre cement sheet) in Part 7 are specific to direct fixing on the cladding to the frame / stud walls.

While there are no specific details for wall (incl. timber) cladding with a ventilation gap, forming a ventilated cavity, we recommend referring to the product manufacturer for product specific details of the depths of the battens and minimum gap to allow for a ventilated cavity when using these materials.

How does each of the following factors contribute to enhancing air circulation

a) placement of the exhaust fan

b) continuous ventilation of the indoor space

c) regular ventilation purges of indoor space

d) heat recovery ventilation replace – instead of an exhaust fan in residential bathrooms or toilets

What preventative measures can reduce mould and condensation in air-tight homes and apartments with poor ventilation, especially when tenants' dry clothes or boil water indoors?

a) Placing an exhaust fan near moisture or odour sources ensures effective air removal. Performance depends on proper ventilation, so windows or gaps may be needed. Consult an expert for optimal placement in your situation.

b) Keeping fresh air circulating prevents moisture and pollutant buildup, supporting good air quality. Specific requirements vary, so professional guidance is advised.

c) Periodic increased ventilation removes stale air quickly. Passive or mechanical methods can be used, but tailored expert advice is recommended.

d) Heat recovery ventilation (HRV)systems exchange stale air for fresh air while conserving energy, offering an efficient alternative. Suitability depends on the building, so seek expert advice.

These are general guidelines; expert advice is recommended for specific situations.

What other alternative method of ventilations to heat recovery ventilation (HRV) are there?

There are generally three types of home ventilation: natural, spot, and mechanical. Natural ventilation depends on air flowing through windows or gaps which can be unpredictable. Spot ventilation targets specific areas, such as a kitchen fan. Mechanical ventilation circulates air throughout the home more consistently. For whole-home systems, options include exhaust-only, supply-only, or balanced systems. Energy recovery ventilators (ERVs) and heat recovery ventilators (HRVs are balanced systems, with ERVs managing humidity in high-humidity climates. The best choice depends on individual home needs, climate, and air quality issues. Consult an expert for tailored advice.

How do you determine if the air circulation is adequate?

To assess if air circulation is sufficient, you can watch for persistent odours or discomfort which may suggest poor ventilation. A hygrometer can help monitor humidity levels, which should ideally be below 60%. An anemometer can check airflow at vents, with a target of 0.25 air changes per hour for each room. Monitoring carbon dioxide (CO_2) levels with a meter, aiming for under 1000 parts per million (PPM) can also be helpful. Condensation on windows may also indicate inadequate airflow. Regular maintenance of fans, vents, and ducts is important. This information is offered as general guidelines. Expert advice is recommended for specific situations.

How can adequate ventilation to a metal clad (e.g. corrugated metal roof), be even considered/ achieved when there is a requirement within AS3959 to install blanket insulation, rockwool or pack the void at a roof to wall junction. Such a measure totally inhibits draught into the small roof cavity i.e. the sheet profile. Packing this void pond condensation water rather than allowing same to drain to the external part of the building. AS3959 does allow fine wire mesh to this space or void. There is no marketed product to fulfill this however and as left to the builder or roofer, metal mesh is rarely used.

AS3959 provides options for how gaps can be sealed in a roof. This detail should be documented at design stage to show how bushfire and condensation provisions of the NCC are complied with. If there are circumstances which demonstrate inconsistencies or difficulties in achieving NCC compliance then a submission should be made to the ABCB via the propose a change website.

What are the ventilation requirements for metal roofs, and how can they be effectively achieved?

What difference will drainage roof battens make under metal roofs-especially flat roofs?

The minimum ventilation requirements for condensation management are outlined in part H4 of NCC volume 2 (which includes part 10.8 of the housing provisions) and part F8 of NCC volume 1.

We recommend consulting a building scientist or expert for specialised guidance on this matter.

How can regulations address condensation problems in vertical exhaust ducts, box gutters, and around fan housings to prevent mould growth?

The regulations rely on the technical provisions within the NCC which continue to evolve with each 3-year cycle. If there are circumstances where a significant issue is identified and can be well documented, then a submission should be made to the ABCB via the propose a change website. Note: when making a change submission please ensure you include examples of what issues you have found and what you may be proposing.

I've noticed condensation on the back side of box gutters. Apart from ventilation of roof space, would insulating them stop this? Seems to be a common and "under the radar" issue.

If there are circumstances where a significant issue is identified and can be well documented then a submission should be made to the ABCB via the propose a change website. Please include examples of what you have identified.

What is the best insulation such as foam etc for shipping containers?

The question about the best type of insulation for shipping containers falls outside our regulatory scope. We recommend consulting an expert for specialised guidance in specific circumstances such as shipping containers.

Which is better for condensation management on low-pitch roofs: insulation foil blankets or membranes, and where should vapour barriers be placed?

In low pitched roofs such as a metal deck roofs the installation of sarking membrane serves as a water control layer for the condensate formed on the underside of the roof cladding. It must be waterproof and some capacity to temporarily drain and detain water can be helpful in low pitched roofs which may not have a clear path of drainage.

What strategies and material choices can effectively manage condensation and mould growth, especially in areas with high moisture levels such as bathrooms or where opposing materials are in close proximity?

Managing condensation and mould in high-moisture areas, such as bathrooms or where opposing materials meet, can involve strategies like improving ventilation, using moisture-resistant materials, and ensuring proper insulation. However, the effectiveness of these approaches depends on the specific conditions of the space. Other methods may include installing vapor barriers or choosing materials that minimize condensation risk. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Can you clarify the allowed installation of standing seam metal cladding profiles per AS1562 and Part 10.8.1 of the HP, particularly regarding moisture management in the cavity?

The need for insulation will be specified through the energy efficiency provisions and it must also comply with condensation management, structure, and weatherproofing. Each of these have different performance requirements and each need to be satisfied independently. The design stage is key to ensuring NCC compliance can be achieved with the proposed solution. Many manufacturers have information available to assist in the design stage.

When reviewing Appendix A of AS1562.1 it should be noted that the information on roof ventilation, water vapour and condensation is 'informative' and is only for information and guidance.

If there are circumstances which demonstrate inconsistencies or difficulties in achieving NCC compliance, then a submission should be made to the ABCB via the propose a change website.

How do you relate condensation with (improper) waterproofing?

When installing a vapour check membrane around an uninsulated concrete element in a facade, should it be linked back to the weatherproof membrane? If so, at what point?

The junction of the slab and external wall is critical to avoiding water ingress. The continuity of protection against water and moisture in the junction depends other different factors including the edge rebate profile, and the location and type of finished surface adjacent to the slab. The NCC provides details of the termination of vapour barriers for slabs (generally at ground level) and the appropriate locations of damp-proofing membranes in external walls in Volume Two Part 4.2.8. Please give careful consideration to the requirements to determine the appropriate and compliant design for your specific situation.

We recommend consulting a building scientist or expert for specialised guidance on this matter.

Is there an acceptable or best practice guide available for builders and designers regarding common roof, wall, and floor construction to manage ventilation and condensation effectively? If not, are there any efforts to create such a guide, either specific to Victoria or nationwide?

The ABCB has published its Condensation in Buildings Handbook which may assist. The Condensation in Buildings - Designers' Guide published by the Tasmanian Government is also a useful guide for cooler climates.

There have been suggestions that roof paper eye ring gutter requirements may change due to mould concerns. What are the current standards, and how will they be updated to address mould issues?

The minimum condensation management requirements are outlined in part H4 of NCC volume 2 (which includes part 10.8 of the housing provisions) and part F8 of NCC volume 1. Guttering systems are regulated through the Plumbing Regulations 2018.

How can masonry/concrete structures like apartments, cladding systems, and other materials be designed or treated to prevent moisture buildup and condensation?

When designing external walls consideration of different factors such as incorporating ventilation, thermal breaks, use of vapour permeable membranes, and applying climate specific designs assist in the mitigation of moisture build-up and condensation. We recommend consulting a building scientist or expert for specialised guidance on this matter.

What are some good products to help with condensation?

There are a number of ways to manage condensation however, the best choice will depend on individual home needs, climate, and air quality issues.

Some simple ways to help manage condensation include enhancing ventilation both naturally and mechanically (such as in bathrooms), considering the use of dehumidifiers, and drying clothing outside whenever possible.

Other methods may include installing vapor barriers or the installation of a heat recovery ventilation (HRV) system. Consult an expert for tailored advice based on the unique characteristics of your building.

What are the best approaches for ventilation and air circulation in commercial and residential properties, particularly in humid environments like Far North Queensland (FNQ), to prevent mould and maintain healthy air quality? Should outside air intake be limited, and how can systems like AS1668 help maintain balanced humidity levels in conditioned zones?

The question relates to humid environments like Far North Queensland, which falls outside our regulatory scope. We recommend consulting a building scientist or expert for specialised and localised guidance on this matter.

As chemicals in plaster get released when in contact with water, should we use some special paint instead of normal paint?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Will steel stud frames create more condensation and mould risk as it is a thermal bridge? Do steel stud frame homes need mechanical ventilation?

Steel has a higher thermal conductivity and responds to temperature changes more intensely than timber. NCC (Volume 1 and 2) provides requirements for the provision of thermal breaks (non-conductive materials) to be installed between the framing and external cladding under the energy efficiency provisions. Several other means can be applied to assist in the mitigation of condensation with steel framed walls, such as the use of ventilated cavities. We recommend consulting a building scientist or expert for specialised guidance on this matter.

In reference to 10.8.3 Ventilation of roof spaces, if a cold roof is installed, such as a truss with insulation on the bottom of the bottom cords, would running a continuous external membrane cause significant issues?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

If we are in climate zone 6 (which most of us here probably are), it means we can't have a continuous external membrane on the roof in a cold trussed roof, as it's technically non-compliant. From my understanding you can't also do a WUFI on this due to the triangular shape of the trusses. How much of a concern is there that mould could accumulate in this space, especially if we were using an intelligent air barrier internally, such as intello and installing an HRV?

The research undertaken by Dr Dewsbury and the University of Tasmania involved hygrothermal and bio-hygrothermal WUFI simulations for nine common wall types in Victorian climate zones. The research did not extend to mould growth risks in roof spaces. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Are there any interior vapour control layers available in Australia? Do you have some product examples?

There are a number of vapour control layer (VCL) products available in the Australian market. These materials or membranes, installed on the inner side of the building envelope reduce vapour transfer into the building fabric. The best choice depends on individual home needs, climate, and air quality issues. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Are there issues with using rigid external foam insulation (not vapour permeable)? If this is exterior to the vented cavity then the insulation would be ineffective.

Using non-permeable rigid foam insulation may lead to inefficiency of insulation and moisture-related problems if it is installed outside of a vented cavity, especially without proper attention to moisture control and air sealing. It is important to balance thermal insulation with vapor and moisture management to ensure long-term durability. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Is there any documentation that shows wall sections/details showing best practice condensation management?

The appropriate detailed section drawing will depend on several factors such as, materials, construction types, location, and other NCC requirements. As such we suggest reviewing details and drawings provided in the ABCB Condensation in Buildings Handbook to help with the applying the condensation management principles to the design of wall and roof systems.

What is the performance of structurally insulated panels (SIP's) in roof and wall applications with respect to vapor permeability and mould compliance?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

Would you recommend installing a vapour barrier on the plaster side of studs and ceiling joints? This is along with one installed on the outside of the insulation.

The purpose of the vapour membrane is to form a barrier that prevents water from reaching the inner structural wall (frame) components. The NCC specifies the installation of the membrane on the exterior side of the primary insulation layer of an external wall.

What is the preferred option in a temperate climate for managing mould and condensation as well as thermal efficiency when comparing a slab on ground construction with a timber subfloor consisting of insulation and vapour permeable membrane.

Mild temperate climate (Climate Zone 6) is characterized by warm summers, cool winters, and moderate humidity levels. It impacts building design, insulation requirements, and energy efficiency regulations. Specific requirements for construction and energy ratings can vary, so it is advisable to consult the NCC or a qualified professional for detailed guidance.

All zones of the external building envelope need equal consideration:

- Subfloor zone needs adequate site design for drainage and ventilation to ensure moisture is managed.
- The roof space zone needs adequate ventilation to remove water vapour that has come from the home and moisture that has condensed on sarking and roofing materials.
- External walls need to control inward moisture and outward water vapour. To do this we need a climatically appropriate mix of ventilated and drained cavity between the cladding system and weather resistive layer, a vapour permeable weather resistive layer and, in more airtight homes, an interior vapour control membrane.

Additionally, to manage relative humidity within the home a mechanical ventilation system could be considered. Please note this is general advice and may not apply to every situation. It is essential to seek expert advice for specific circumstances.

Do the following factors contribute/prevent to mould issues:
a) ceiling height tiles being cold
b) sealing a home against mould
c) bathroom that doesn't have an external wall/window
d) unheated bedroom being closed all the time
e) removal of the requirement for 9" x 6" wall vents
f) excessive insulation in the walls without air flow

To mitigate condensation and mould growth different environmental factors, occupancy behaviour, and design factors, functions of the space need to be considered together. In isolation, the holistic solution to prevent or understand factors is unlikely. Below is some guidance to answer the questions.

a) Wall surfaces (tiles). Generally, when warm moist air comes in contact with cold surfaces, the temperature of the air drops forming liquid on these surfaces.
c) and e) Poor ventilation / air flow (natural to external or mechanical). Lack of these increases the likelihood of condensation occurring which may lead to mould growth. This can affect an unheated

room depending on external wall temperature changes.
b) and f) Wall envelope construction. As noted above air flow (allowing the building to breath) is required to help mitigate condensation and mould growth.

How can builders prevent mould growth on timber frames during construction? At what point do you replace materials rather than dry and clean them?

How can building frames (timber, pine, softwood, and steel studs) be protected from moisture and mould, and are additional measures like drying or treating frames necessary after water exposure?

Builders frequently encounter issues with mould during timber transit, storage, and construction. Research published in 2023 highlights the importance of using vapour-permeable wrapping for timber during transit to prevent damage. Timber should be stored in weather-protected areas with plastic coverings removed.

Mould growth during construction is rare but can occur with insufficient ventilation or excess moisture. Mould grows in conditions where temperatures exceed 5°C and humidity surpasses 60%. Ensuring proper ventilation helps timber dry naturally preventing long-term mould growth.

While visible mould in habitable spaces is a health concern construction sites differ as they are better ventilated, reducing the risk of inhaling mould spores. In cases where timber is severely damaged or structurally compromised, consulting a building hygienist or structural engineer may be necessary.

How can the source of moisture for a mould outbreak be identified? For example, how do you determine whether moisture in the sub-floor or high levels of condensation are the cause?

Suitably qualified and experienced practitioners will use a number of methods to identify the moisture source responsible for mould growth. Typically this will include undertaking a visual inspection of the affected area and the utilisation of specialist tools such as moisture meters, humidity probes, and thermal imaging cameras. Given the complexity of each situation, it is best to consult an expert.

Does leaving a house locked up and vacant for several months significantly contribute to mould formation?

Leaving a house locked up for a month can promote mould growth due to dust accumulation and lack of ventilation. Dust provides food for mould, especially in damp environments, while poor ventilation leads to moisture on surfaces such as windows and walls. Rooms may become warm during the day and cold at night causing moisture condensation which supports mould growth.

To help prevent this, you may need to:

- maintain ventilation by opening windows or using exhaust fans
- schedule inspections to catch moisture problems early
- remove damaged materials after addressing the cause of moisture
- keep humidity below 60% and ensure cupboards and wardrobes are well-ventilated.

This is general advice and may not apply to every situation. It is essential to seek expert advice for specific circumstances.

How can condensation and mould be effectively managed in windows, particularly aluminium, double-glazed, and single-glazed, in new construction when dealing with varying internal and external temperatures (e.g., heat inside, cold outside, blinds/curtains)?

Managing condensation and mould on windows can involve strategies such as enhancing ventilation, using thermal breaks, and selecting appropriate glazing. The effectiveness of these methods depends on factors including temperature differences, insulation quality, and window coverings (e.g., blinds or curtains). In some cases additional measures like dehumidifiers or improved window seals may be required. Given the complexity of each situation we recommend consulting a building scientist or expert for specialised guidance on this matter.

How can condensation be effectively managed on double-glazed windows in an alpine environment?

Managing condensation and mould on windows can involve strategies such as enhancing ventilation, using thermal breaks, and selecting appropriate glazing. The effectiveness of these methods depend on factors including temperature differences, insulation quality, and window coverings (e.g., blinds or curtains). In some cases, additional measures such as dehumidifiers or improved window seals may be required. Given the complexity of each situation, we recommend consulting a building scientist or expert for specialised guidance on this matter.

What are the solutions for mould growth due to rising damp in the foundations of an existing home?

To address mould growth from rising damp:
- ensure a functional damp-proof course and improve drainage around the foundation.
- enhance ventilation, especially in subfloor areas, and consider using dehumidifiers if needed.
- clean existing mould with appropriate products or seek professional help for severe cases.
- improve insulation and apply moisture barriers to help prevent future issues.
- regularly monitor for dampness to catch problems early and prevent recurrence.

This is general advice and may not apply to every situation. It is essential to seek expert advice for specific circumstances.

How can condensation on precast concrete walls, where the inside is covered by plasterboard, be addressed in residential and commercial buildings?

Managing moisture in single-skin concrete structures can be complex. For cladding systems such as brick veneer or lightweight cladding, a ventilated and drained cavity is recommended to allow moisture to escape. Single-skin structures however, lack drainage planes trapping moisture inside. Research shows that 1-7% of moisture enters through cladding and condensation can occur inside leading to mould issues.

In some countries insulation and a vented cavity are added to exterior walls to prevent condensation. Interior vapour control layers can help but are prone to gaps. This is an area requiring further research, especially for Australia's single-skin concrete buildings.

Can poor fan positioning create areas of static air?

Yes, poor fan positioning can create areas of static air. Fans need to be strategically placed to promote even air circulation. If positioned incorrectly some areas may receive little to no airflow leading to stagnant air. This can cause discomfort and contribute to issues like mould growth or uneven heating and cooling. To avoid this fans should be placed to optimise airflow patterns throughout the space. This is general advice and may not apply to every situation. It is important to seek expert advice for specific circumstances.

Are elevated moisture levels within homes built directly along the coastline (100m to 300m from water) expected or acceptable, and how should these homes be compared to inland homes?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

What weather and thermal performance conditions cause condensation issues?

Condensation generally forms when warm moist air comes into contact with a cold surface which forms water droplets. This effect is subject to the thermal performance of a building, the ambient weather conditions, and the temperature preferences of the occupants. For example, cold weather means people turn on heating indoors which combines with water vapour in the air which contacts a cooler surface of a window allowing the formation of water droplets.

Can cold-formed roof trusses and structures increase condensation in southern Australian regions?

Condensation can occur in different parts of the building for different reasons. We recommend consulting a building scientist or expert for specialised guidance on this matter.

How does a vented roof space with anti-condensation blank work compared to a ventilated cavity roof system in terms of managing condensation?

The minimum condensation management requirements are outlined in part H4 of NCC volume 2 (which includes part 10.8 of the housing provisions) and part F8 of NCC volume 1. Given limited details, we recommend consulting a building scientist or expert for specialised guidance on this matter.

Is condensation possible in roof apron flashings, and what is the best way to address it?

Condensation can occur in different parts of the building for different reasons. Generally, improvements to ventilation and drainage mitigate condensation. We recommend consulting a building scientist or expert for specialised guidance on this matter.

How can mould be safely removed from insulated wall cavities without wall demolition?

Suitably qualified mould removal specialists, subject to the condition of the structure may be able to treat mould within insulated wall cavities using non-destructive treatment methods,. The required remediation solution will be specific to the area being treated and may include the use of commercial biocides. However, it is important that the root cause of the moisture is addressed to reduce the risk of future mould growth.

What are the best practices for preventing and removing mould in roof cavities, particularly above internal swimming pools?

Are there specific recommendations for roof cavity ventilation to prevent mould and structural deterioration?

What standards apply when constructing an indoor swimming pool?

What standards should be followed for building envelopes in special environments like indoor heated swimming pools?

Simply cleaning mould is not a complete solution. Mould is always present in microscopic form, but it only becomes harmful when visible spores develop. To effectively address mould, we need to:

- Identify and eliminate the root cause, such as moisture, poor ventilation, or other factors that create high humidity.
- Clean affected surfaces, though cleaning alone may only remove visible mould without addressing the underlying issue.
- Consult an expert for tailored advice based on your circumstances and the unique characteristics of your building (or special environments like indoor heated swimming pools).

The minimum condensation management requirements are outlined in part H4 of NCC volume 2 (which includes part 10.8 of the housing provisions) and part F8 of NCC volume 1.

We recommend consulting a building scientist or expert for specialised guidance on this matter.

How can workers protect themselves when dealing with mould, such as mould caused by leaks under a basin contained in a cupboard?

Mould associated with damp buildings can trigger nasal congestion, sneezing, cough, , respiratory infections and may worsen asthma and allergic conditions. Workers should wear Personal Protective Equipment (PPE), such as a properly fitted P2 mask/respirator, gloves and safety glasses to protect themselves against mould exposure and to prevent the spread of mould to other areas.
You should seek medical advice if you are concerned about the effects of mould. For more information see the Better Health Channel.

What are the most effective methods and products for preventing and dealing with mould in domestic and commercial structures, including in softwood and timber frames, silicone areas, and building materials?

Consideration of different factors such as incorporating ventilation, thermal breaks, use of vapour permeable membranes and applying climate specific designs assist in the mitigation of moisture build-up and condensation. We recommend consulting a building scientist or expert for specialised guidance on this matter.

What are acceptable humidity levels for domestic and commercial buildings, and should dehumidifiers with automatic sensors be considered for maintaining these levels?

Acceptable humidity levels for domestic and commercial buildings are generally considered to be between 30% and 60%, but ideal levels can vary based on specific conditions. While dehumidifiers with automatic sensors may help maintain these levels, their suitability depends on individual circumstances. In some cases other methods may be more appropriate. It is important to assess the specific environment and consider consulting an expert to determine the best solution for managing humidity.

We provide building consulting services for insurance companies. Over the past 20 years, I have regularly observed plaster ceiling failures in tiled-roof garages of residential buildings. These failures are often caused by small moisture particles accumulating in the roof or ceiling cavity, which settle on the back of the plaster and gradually cause distortion between the fixing and adhesive points. Given that garage (Class 10) ceilings are not required to be insulated like dwelling (Class 1) ceilings, what measures can be taken to prevent this issue from occurring? How can mould on plaster ceilings be controlled?

Please refer to the ABCB Condensation Handbook for advice on measures to help mitigate condensation beyond those provided in the NCC.

We recommend consulting a building scientist or expert for specialised guidance on this matter.

How can mould growth be prevented in anti-fungal silicone applied around grate drains and at the base of glass shower panels?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

How to most effectively deal with existing mould?
What are the main causes of mould, its health risks, and the most effective methods for prevention, mitigation, and removal?
What's the best way to kill mould?

Simply cleaning mould is not a complete solution. Mould is always present in microscopic form, but it only becomes harmful when visible spores develop. To effectively address mould, we need to:

- Identify and eliminate the root cause, such as moisture, poor ventilation, or other factors that create high humidity.
- Clean affected surfaces, though cleaning alone may only remove visible mould without addressing the underlying issue.
- Consult an expert for tailored advice based on your circumstances and the unique characteristics of your building.

What factors lead to mould in external building elements? Such as fascia boards and eave linings

Mould on external building elements, like fascia boards and eave linings can result from several factors including excess moisture, poor ventilation, lack of sunlight, and inadequate maintenance. Climate, building materials, and construction quality also play a role. However, the exact cause can vary depending on the specific situation. It is important to assess the unique conditions of the building and consider consulting a professional for tailored advice on preventing and addressing mould growth in these areas.

What are your recommended mould treatment methodologies for mould on weather exposed timber frames?

Builders frequently encounter issues with mould during timber transit, storage, and construction. Research published in 2023 highlights the importance of using vapour-permeable wrapping for timber during transit to prevent damage. Timber should be stored in weather-protected areas with plastic coverings removed.

Mould growth during construction can occur with insufficient ventilation or excess moisture. Mould grows in conditions where temperatures exceed 5°C and humidity surpasses 60%. Ensuring proper ventilation helps timber dry naturally, preventing long-term mould growth.

In cases where timber is severely damaged or structurally compromised consulting a building hygienist or structural engineer may be necessary.

How effective are dehumidifiers to manage mould growth?

Dehumidifiers can be effective in managing mould growth by reducing indoor humidity which inhibits mould development. They help maintain moisture levels below 60%, a threshold where mould typically thrives. However, their effectiveness depends on factors like room size, airflow, and existing mould levels. Dehumidifiers are best used as part of a broader mould management strategy, including cleaning and addressing underlying moisture issues. Since results can vary case by case it is advisable to consult an expert for specific recommendations tailored to your environment.

Can these principles be applied to public buildings? Are there recommendations for these classes of buildings?

Condensation management principles for residential buildings, such as improving ventilation, insulation, and controlling indoor humidity, can generally be applied to public buildings. However, public buildings often have unique considerations including larger spaces, varying occupancy levels, and specific regulatory requirements. Tailored solutions might include enhanced heating, ventilation, and air conditioning (HVAC) systems and building envelope design adjustments. Recommendations for public buildings depend on their specific use, location, and design, so it is important to seek expert advice to address the particular needs and conditions of each building.

Have had a new development experiencing condensation on the inside of bedroom wardrobes. Can you please advise why this may be the case? The building is well built in relation to NatHERS and Energy efficiency, with double glazed windows.

I have a new build only 6 months old and during our cold winter we had this year west facing bedroom single glaze window had a lot of condensation it was like someone ran a hose over the glass. The house is well insulated as per the energy reports.

It is important to understand how condensation can occur even in newly built homes as a result of a variety of factors, regardless of compliance with energy efficiency requirements. Condensation generally occurs when moist air comes into contact with cold surfaces. This will occur even in well built homes as a result of temperature variations between and during day and night, exposure to weather elements from building orientation, and occupant behaviour, all of which provide moisture to the indoor air.

Measures to mitigate condensation are largely related to improved ventilation and understanding occupant behaviour and how it may contribute to mitigating the occurrence of condensation. For example , opening windows daily, including walk-in-robes, avoiding drying clothes inside, ensuring all exhaust fans work and are used.

Additionally, to manage relative humidity within the home a mechanical ventilation system could be considered. Please note this is general advice and may not apply to every situation. It is essential to seek expert advice for specific circumstances.

I see more and more frames left exposed for extended periods (e.g., >3 months) with no roofing installed with some obvious darkening of the timber, then they put the roof on and wall cladding etc. What should then be applied to the darkened framing now inside the building?

Builders frequently encounter issues with mould during timber transit, storage, and construction. Research published in 2023 highlights the importance of using vapour-permeable wrapping for timber during transit to prevent damage. Timber should be stored in weather-protected areas with plastic coverings removed.

Mould growth during construction can occur with insufficient ventilation or excess moisture. Mould grows in conditions where temperatures exceed 5°C and humidity surpasses 60%. Ensuring proper ventilation helps timber dry naturally, preventing long-term mould growth.

In cases where timber is severely damaged or structurally compromised, consulting a building hygienist or structural engineer may be necessary.

Is there a system that can measure condensation and mould risk once the home is complete?

Moisture meters and relative humidity probes are widely used by industry to detect moisture levels within a home post construction and are useful in assessing whether building materials contain enough moisture to support mould growth.

In terms of modelling the condensation and mould growth risk, there are a number of advanced computational fluid dynamics (CFD) software solutions available in the marketplace that are used by building designers to model how heat is transferred through a home. CFD can use inputs such as airflow, temperature and humidity to predict mould growth risk.

What are the solutions that could improve ventilation for homes under 8ACH (air changes per hour)?

Several factors can affect ventilation, such as spending time at work or home, outdoor noise, cold weather, security concerns limiting window use, and the effectiveness of cross-ventilation. Improving low air changes per hour (ACH) can enhance indoor air quality and comfort. Options include:

- Balanced mechanical ventilation (HRV or ERV), which provide both supply and exhaust air.
- Exhaust-only systems, needing an open window for fresh air.
- Supply-only systems, also requiring a window for air exhaust.

The best solution varies by situation, so expert advice is recommended for your specific needs.

What are the choices of products for air exchange systems that run full time and power draw?

There are many types of Heat recovery ventilators (HRV) and Energy Recovery Ventilation Systems (ERV) available on the market for use in Australia. Power draw will be dependent on the size of the building and the system installed. The best choice depends on individual home needs, climate, and air quality issues. Please consult an expert for tailored advice on the required solutions.

What are the best practices for mechanical ventilation and heat recovery systems in residential and commercial properties, especially in humid environments, to prevent mould and manage indoor air quality?

How effective are retrofitting ventilation systems like HRV in mitigating mould and dampness issues in existing buildings?

What type of mechanical ventilation is best for Melbourne. HRV or ERV?

By improving ventilation and controlling humidity, heat recovery ventilators (HRV) and energy recovery ventilation systems (ERV) may improve indoor air quality and reduce the likelihood of mould recurrence. These systems continuously supply fresh air while exhausting stale air, which reduces indoor humidity levels and prevents moisture buildup. These are general guidelines. Please consult an expert for tailored advice on the required solutions.

What techniques and retrofitting systems can mitigate dampness and mould in older solid or cavity masonry buildings with suspended concrete slab roofs?

We recommend consulting a building scientist or expert for specialised guidance on this matter.

Is an HRV system sufficient for moisture protection if no vapour check membrane is installed internally to the thermal layer?

Generally, improvements to ventilation mitigate condensation. Given limited details, we recommend consulting a building scientist or expert for specialised guidance on this matter.

Naturally the builder takes risk on all works, but what trade is responsible for condensation and mould? Has this been built into code?

The builder oversees the overall construction process and is responsible for the quality of the build. Issues might arise from design, material choice, or construction practices that didn't adequately address moisture management. All members of the design and construction team need to be well informed and apply climatically appropriate methods. Complying with the requirements does not guarantee that condensation won't occur. Liability will need to follow the defects process outlined in the Consumer Affairs Victoria website, which may require involvement of the Domestic Building Dispute Resolution Victoria.

In addition to the NCC requirements, builders can seek guidance from the ABCB Condensation Handbook and the Condensation in Buildings - Designers' Guide published by the Tasmanian Government. These guidance documents provide general advice and may not apply to every situation. It is essential to seek expert advice for specific circumstances.

When will proper air handling and ventilation requirements, similar to those overseas, be reviewed and implemented alongside airtight building standards?

Australia has been actively updating its air handling and ventilation requirements to improve indoor air quality and energy efficiency. The most recent significant update was introduced in the National Construction Code (NCC) 2022. This update included new ventilation requirements, particularly for buildings with less than 5 air changes per hour (ACH), ensuring better indoor air quality and energy efficiency.

There are further proposed changes currently being considered for NCC 2025: see the Australian Building Codes Board (ABCB) website. The proposed NCC 2025 changes for condensation management include the introduction of a higher vapour permeable membrane in Climate Zones 1-5, a drained and ventilated cavity and/or Class 4 vapour permeable membrane in Climate Zones 6, 7 and 8, and additional roofing ventilation requirements. The final changes are yet to be finalised by the ABCB.

What are the NCC requirements for moisture content before installing linings?

How can the new build construction process prevent mould growth during the lock-up stage, including ensuring that moisture content is properly inspected and managed in the framework before plaster installation?

The NCC itself does not specifically prescribe moisture content levels before installation of linings however, the NCC Governing requirements in Part A5G1 specify that building materials must be fit for purpose. We advise you to speak to a specialist in timber (such as wood solutions) for a more definitive answer for pre-lining moisture content requirements for timber.

For additional reference, AS1684.2 Residential timber-framed construction Appendix E provides informative details about moisture content levels in timber floors at the time of installation. This is a referenced Standard in the NCC, noting Appendix E is informative.

Is there a plan for a department to address the detrimental effects of materials and methods, like ACP and direct fix claddings, especially in Victoria?

Cladding Safety Victoria has been established by the Victorian government to address and rectify higher-risk residential apartment buildings with combustible cladding such as ACP. For more information: www.vic.gov.au/cladding-safety.

Has it been a requirement since NCC 2019 to install a Vapour Permeable Membrane in Brick Cavity Construction?

NCC 2019 saw the introduction of new Condensation Management DtS provisions for the use of pliable building membranes in external walls, with the exception of single skin masonry walls.

Have Reflective Foil (Breather) products been acceptable to use since NCC 2019?

NCC 2019 Energy Efficiency requirements included the use of reflective foil which could also act as a vapour barrier membrane. This section also included a reference to the new condensation Deemed-to-Satisfy (DtS) requirements.

What changes are anticipated in the NCC that will reduce the risk of condensation and mould?

NCC 2025 public comment draft was advertised between May and July 2024 with the proposed changes still available for review through the Australian Building Codes Board (ABCB) website. The proposed NCC 2025 changes for condensation management include the introduction of a higher vapour permeable membrane in Climate Zones 1-5, a drained and ventilated cavity and/or Class 4 vapour permeable membrane in Climate Zones 6, 7 and 8, and additional roofing ventilation requirements. The final changes are yet to be finalised by the ABCB.

Is sarking installation under metal roofs required by the NCC?

Can you explain permeable and non-permeable insulation and their use in metal roofing and wall cladding?

Why is sarking not legislated to be installed under metal roofs?

Vapour permeable membranes are waterproof membranes that allow water vapour to pass through them but stop liquid that has penetrated the building fabric (walls or roof) from entering the building.

Sarking is normally used for purposes such as waterproofing purposes, vapour proofing and thermal reflectance. However, as metal roofs are principally designed to shed water and do not rely on a internal drainage system, sarking is not mandatory under a metal roof unless the building is in a Bushfire Attack Level (BAL) defined area.

We suggest a holistic assessment of other requirements that may result in its use which may include, location, climate (humidity levels) factors, exposure to wind driven rain other energy efficiency requirements.

What factors can cause mould in a building that are not specifically addressed in the BCA (Building Code of Australia)?

The NCC sets the minimum standards to prevent excessive moisture entering a building moisture through condensation, damp and weatherproofing provisions. In addition to these requirements, ongoing maintenance and careful management of how the building is used (e.g. ventilation, avoiding excessive moisture generation) would help prevent mould growth.

Can a Municipal Building Surveyor issue a Building Order requiring evacuation and rectification of a building affected by Mould?

Yes an MBS may cause a building to be evacuated if they are of the belief that the building is unfit for occupation. The Building Act provisions are not directly linked to compliance, and therefore allows a degree of discretion in the application of the provisions.

What are the key regulations and documentation requirements that impact facade engineering, ventilation systems, and moisture management during construction and post-occupancy?

The minimum condensation management requirements are outlined in part H4 of NCC volume 2 (which includes part 10.8 of the housing provisions) and part F8 of NCC volume 1.

Should plumbers need to adhere to broader building regulations?
Should the VBA register Building physician rather than relying on a star rating or CodeMark system

Licensed and registered plumbing practitioners are required to comply with the relevant provisions of the Building Act 1993, the Plumbing Regulations 2018 and Vol 3 of the NCC, and the Building Regulations where there is overlapping obligations.

New registration categories are policy matters for consideration by the Department of Transport and Planning.

Doesn't the requirement for ventilation and air-tightness contradict each other?

It appears that our energy efficiency requirements have outweighed our health requirements, now we need to fix this problem

How do you balance sealing a building for thermal performance with the risk of increased condensation?

Fundamentally addressing the balance of thermal performance requirements and mitigation of condensation is achieved through careful design and construction of the building envelope. Working with a building designer and thermal performance consultants can ensure that a balance is achieved.

Is the air-tightness requirement noted (10m3/h/m2 @50Pa) mandatory? My understanding is that homes that follow a DtS path don't have to undertake blower door testing.

The air-tightness requirement of $10m^3/h/m^2$ @ 50Pa is referenced in the National Construction Code (NCC), but whether it is mandatory depends on the compliance path chosen. Homes following the Deemed-to-Satisfy (DtS) path generally do not require blower door testing, though achieving airtightness may still be beneficial. However, specific requirements may vary based on building classification, climate zone, and other factors. It is advisable to consult with a building professional or expert to determine the best compliance approach for your project under the NCC.

Is it possible to have simple DTS provisions for both condensation and thermal requirements of the BCA?

The Australian Building Codes Board (ABCB) is responsible for developing and maintaining the building code of Australia (BCA), which forms part of the National Construction Code (NCC).
The NCC is revised every three years, with NCC 2025 is currently under review. Further changes to manage the risk of condensation are proposed, including Deemed-to-Satisfy (DTS) provisions for external walls and roof ventilation. A proposal for change can be made to the ABCB mid-cycle, if considered appropriate.

Recent research from Commonwealth Scientific and Industrial Research Organisation (CSIRO) has shown that many new homes are being built with air-tightness levels that should require mechanical ventilation in the NCC - but would only be required if they had blower-door tested them, otherwise in this NCC this requirement can be ignored. When will this contradiction be addressed?

The CSIRO research included a range of recommendations, including establishing air tightness standards in the National Construction Code (NCC).

The Australian Building Codes Board (ABCB) is the standards writing body responsible for the NCC. The NCC is updated every 3 years, based on required regulatory practices, industry research, public feedback and policy directions from governments between publishing cycles.

Is the hygrothermal simulation approach for different regions in Australia?

The research undertaken by Dr Dewsbury and the University of Tasmania involved hygrothermal and bio-hygrothermal WUFI simulations for nine common wall types in Victorian climate zones. We understand the WUFI (Wärme und Feuchte Instationär) hygrothermal simulation approach is adaptable and could be used to model hygrothermal performance of building components in various Australian climates. It is recommended you seek expert advice for specific circumstances.

Is there any software to model airflow?

A number of software vendors provide advanced software solutions to model airflow within buildings. The CSIRO, in partnership with the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) developed AccuRate to enable building designers to model how heat is transferred through air movement, in combination with other elements of a building including solar radiation, shading effects, internal heat loads and concrete slab ground coupling effects.

Can a psychometric chart analysis help understand why warm moist air hitting cold glass or wall surfaces has its moisture removed, which is the opposite of what happens with a cold glass of water on a hot day?

A psychrometric chart graphically represents the properties of moist air including temperature, humidity, and dew point. By plotting the initial conditions of the air (temperature and humidity) on a psychrometric chart, you can trace the cooling process as the air hits the cold surface. The chart will show how the air moves towards the dew point line, indicating where condensation will occur.

How can we effectively use different WUFI assessments that assign varying material sensitivity classes to the same materials, especially when these assessments are not always aligned with DA07?

Firstly, the builder or homeowner needs to ascertain the skill-level of the person performing the service.

Secondly, the climate data selected will have a major impact on simulation results. The data should include hourly measured values for air temperature, relative humidity, solar radiation, and rain.

Thirdly, the sensitivity of materials relates to the ability to support mould growth. If a wall is made from softwood framing that sensitivity class should be selected. If a wall is made from steel framing, the next most sensitive material being the insulation product should be selected. Additionally in a steel framed wall, a corrosion assessment should be made.

Is the work on improving weather files for better modelling of wind-driven rain ready for use in simulations?

We have been advised that researchers from the University of Tasmania, the University of Sydney, the Australian Institute of Architects, and the Australian Institute or Refrigeration, Air-conditioning and Heating (AIRAH), have been liaising with the Fraunhofer Institute of Building Physics and an Australian climate data provider to have in the 2024 WUFI updates:
- one climate file located where the most construction has been occurring near each capital city, included for free, and
- a large number of other climate files that would provide a more accurate place-based simulation result available for a fee.

Since WUFI may not detect moisture buildup in that area, could Intello be a solution for managing moisture on the ceiling?

As a regulator we provide general advice in relation to the application of building and plumbing standards. We recommend consulting a building scientist or expert for more accurate and specialised guidance on this matter.

What is Melbourne climate zone?

According to the Nationwide House Energy Rating Scheme (NatHERS) and the National Construction Code (NCC), Melbourne generally falls within Climate Zone 6, described as a mild temperate zone - see climate zone map. This classification is characterized by warm summers, cool winters, and moderate humidity levels. It impacts building design, insulation requirements, and energy efficiency regulations.

What is the role and location of insulation within the building envelope as a possible controlling factor in condensation/dewpoint management.

Insulation in the building envelope helps manage temperature variation between internal and external parts of the building. This effectively reduces the capacity of warm moist air to cool down quickly. For example, cold spots in wall cavities would be more susceptible to condensation occurring due to lack of insulation. While placement of insulation plays a role in condensation management, we recommend you consider other factors such as air movement and the placement of the moisture barrier within the external wall.

We recommend consulting a building professional or expert for specialised guidance on this matter.

In your slide on the evolution of clad wall systems, if you use rigid insulation between the frame and the vapour barrier, will air vapour move through the rigid insulation?

Rigid insulation generally has low vapour permeability but this may vary between products and manufacturers. When specifying a product in a building the parameters need to be known to ensure compliance is achieved and a high performing outcome meeting minimum standards. We recommend consulting a building scientist or expert for specialised guidance on this matter.

If we're trying to increase airtightness to reduce reliance on heating and cooling to reduce carbon emissions of housing, why are we heading toward using petrochemical products such as rigid foam board in every house that have all manner of lifecycle problems.

The reference to 'rigid foam board' during the webinar was an example to illustrate the evolution of wall designs, not a recommendation. The National Construction Code (NCC) requires 'evidence of suitability' for any products or systems used in building work, including assurance of their application, compliance, and any limitations. Material sustainability and lifecycle impacts should also be considered.

What is relative humidity simply explained?

Relative humidity is an indicator of the air's moisture content. It is the ratio of the amount of moisture actually in the air compared with the maximum amount of moisture which the air could hold at the same temperature. Relative humidity is normally expressed as a percentage and at saturation the relative humidity will be very close to 100%. The air can hold more moisture at higher temperatures, hence the relative humidity alone does not give an absolute measure of moisture content.

How can long-term moisture damage to electrical and mechanical services in ceiling spaces be prevented?

The NCC requirements for ventilation openings for roofs with varying pitches are available and can be found Tables F8D5 in NCC Volume One and 10.8.3 of the Housing Provisions. Generally, moisture damage in ceiling spaces can be prevented through sufficient ventilation. We recommend seeking advice from licensed electricians and mechanical services engineers on any specific ventilation requirements for electrical and mechanical services.

What is the difference between rot and mould in terms of bacteria types and why will one occur and not the other as they seem to live in the same conditions

Wood decaying fungi rely on high moisture content within the timber and break down the cellulose, hemicellulose and(or) lining of the timber leading to potential weakness of the structure. Mould typically grows on the surface of materials in areas of high humidity and where surface moisture exists and poses potential health risks to the occupants.

Is there likely to be explicit recognition of Passivhaus methods of design and operation by the VBA, as an ideal outcome? I.e. vapour open construction and continuous ventilation with heat recovery. Certified projects have a level of assurance that would assist performance improvement in housing sector

It seems to me that the Europeans have had this problem solved for years: Passivhaus standards address all of these issues (insulation, thermal bridges, vapour permeability, mechanical ventilation, etc). Why are we attempting to re-discover what has for 20+ years been a solved problem in climates that are even more likely to encourage condensation and mould problems than Australian climates?

The NCC sets the minimum required level of safety, health, amenity, accessibility, and sustainability of buildings in Australia. Climatic variations, overall cost benefit to society, restrictiveness of regulation, and proportionate responses to issues are a few of the considerations that are taken into consideration when developing the content of the NCC.

As the NCC is a performance based Code, the application of Passivhaus standards could be considered through the performance pathway under the NCC. In addition, a proposal for change to the NCC can be made to the ABCB at any time, if considered appropriate.

What would be the approximate increase in cost of a wall compared to the standard we have now, if we followed all of your suggested best practice measures?

The suggested best practice measures as informed by the research undertaken by Dr Dewsbury and the University of Tasmania are based on hygrothermal and bio-hygrothermal simulations for nine common wall types in Victorian climate zones. Variations in costing lie outside the scope of the research. The ABCB has conducted a cost-benefit analysis for proposed changes to NCC 2025 on condensation mitigation, this analysis may provide some useful considerations: www.abcb.gov.au/pcd/pcd-2025-condensation-mitigation.

For technical information or clarification please contact the Technical and Regulation Team via technicalenquiry@vba.vic.gov.au. For information about the research, please contact the Research and Evaluation team via research@vba.vic.gov.au.

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