TechDirect™ White Paper

Condensation

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1. INTRODUCTION

Condensation is increasingly becoming a significant topic of concern for homeowners, its presence can cause mould and mildew to form, contributing to unhealthy living environments.

Due to their immediate exposure to external temperatures, single glazed windows will easily create high levels of moisture to form on inner glass surfaces. A more recent contributor to condensation on windows has been thermal improvements to building envelopes (wraps and sarking), which has led to more air being trapped inside where there were once vents and gaps in building structures.

The industry is calling for construction methods and products that enable moisture-laden air to be released from internal building spaces without internal temperature losses.

2. BACKGROUND

This document aims to provide an overview of condensation, its contributing factors, causes and effects, with selection of appropriate building materials and design methods to help combat condensation occurring.

The information provided is general in nature, specifically related to glass only and does not include other building materials which may also contribute to condensation occurring.

What is condensation?

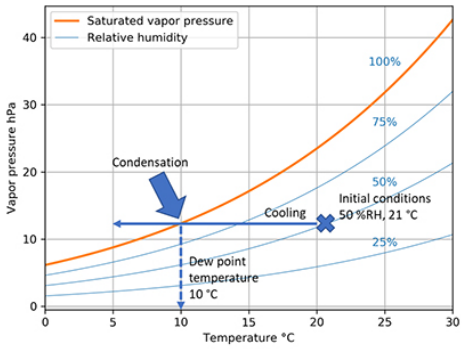
Condensation is the process of water vapour changing back into a liquid form. When the liquid is unable to dry as readily as it forms, it will accumulate causing unwanted moisture on building surfaces.

Air will always contain a certain level of moisture, known as humidity, with warm air able to hold more water compared to cooler air. When moisture in the air meets a cooler surface such as glass, condensation is formed. The temperature at which this happens is known as the “dew point”. The dew point will vary depending on the level of humidity.

Windows in a home can have significant temperature variations across its components. This is influenced by glass types, framing systems, air movement, spacer material in IGUs, sealants, etc. Factors external to the windows can also impact condensation, such as wind speeds, curtains, shades, blinds, air conditioners and fans.

Condensation is a climatic condition. Glass does not cause the condition therefore it is not considered a product fault.

Diagram 1. Dew Point Temperature



How can condensation be managed?

Standard household behaviours such as cooking, bathing, drying and heating, can contribute to increased levels of humidity which form condensation. Additionally, building materials such as windows, doors, floors and roofs, can leak humidity in homes.

The best way to combat condensation is to manage the humidity levels. When humidity is high this can be achieved by improving ventilation and air movements, dehumidifiers, air conditioning and maintaining moisture outside.

Whilst reducing humidity is good, if levels get too low this can result in dryness and irritation for humans which can be experienced as dry eyes or cracked lips. Lower humidities can also host airborne viruses, causing them to spread more easily. Some humidity is necessary for human comfort, so finding the balance between comfort and condensation is critical.

An alternate method of reducing condensation is by increasing the surface temperature of cold materials where moisture condenses. Single glazed glass in a window is usually the coldest surface in a room and is often the first place water condensates.

Diagram 2. Surface temperatures

When does condensation occur on a glazed panel?

Condensation forms quite differently depending on whether it is on the inside or the outside of the building. It will appear on the surface of a glazed panel if the temperature on this face is significantly lower than the adjacent air temperature, and if the dew point of the adjacent air is higher than the temperature of the glass.

This is influenced by 3 factors:

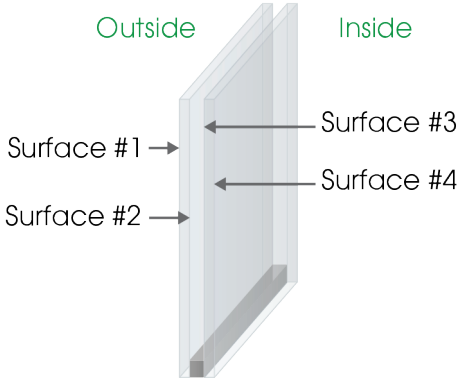
- Heat flow from the interior passing through the glass.
- Heat exchange by convection with the external air (relevant for single glazing).
- Heat loss by radiation mainly to the sky or open air.

Condensation is unsightly and can hinder views, destroy frame materials, drip on floors and even freeze on glass surfaces. The balance of ventilation and airtightness in your home can either reduce or increase the risk of condensation depending on how the different materials and construction methods interact.

Condensation on the external face

Surface #1 is defined as the outside face of a glazed panel, refer to diagram 2. The coldest point on the external face is generally in the centre with the edges likely to be warmer if placed in conductive frames.

Diagram 2. IGU Surface Numbering



The surface temperature of single glazing is rarely lower than the external air temperature, so condensation rarely occurs on the external face. However, improved thermal insulation by introducing double glazing reduces the heat transfer to the external surface, making it cooler and increasing the risk of some external condensation. This is generally seen in combinations of colder nights, clear cloudless weather without wind and well insulated glazing systems.

External condensation can be evidence that your windows are performing well and are actively reducing the heat loss in your home through the glass. Heat exchange by radiation is relatively limited in overcast weather. However, without cloud cover at night, there are significant heat losses to the open sky which further cools exposed surfaces.

To illustrate the effect of increased radiant heat loss, consider a car parked outdoors at night in clear cloudless weather. In the early hours of the morning, some parts of its outer surface are wet or frosted without any evidence of rain. However, when the car is parked with protection alongside a solid fence or structure, the windows on the protected side are dry, because this significantly reduces the radiant heat exchange between the car windows and the open sky.

IGUs and Low E coatings help to insulate the airspace between glass and improve the overall thermal performance of the unit. As a result, the external surface does not get warmed by heat escaping from inside the building. If the outdoor humidity is low and wind is moving air against the glass, external condensation is very unlikely. But on cool, still, clear nights when humidity is high, external condensation will likely appear for a short period before evaporating when the sun comes up and warms the air.

Condensation on the internal faces of an IGU

Surfaces #2 and #3 are defined as the internal faces of a glazed panel, refer to diagram 2.

The internal cavity of an IGU is hermetically sealed and contains moisture absorbing elements that eliminate any moisture present during manufacturing. Any small amounts of moisture remaining is held and not evident for the effective life of the unit.

If condensation forms on the internal surfaces of a double glazed unit, this indicates that the air or gas cavity is no longer completely sealed allowing outside moisture to enter, saturating the moisture absorbing desiccant. This is deemed as a unit failure and the double glazed unit must be replaced.

This issue is commonly a consequence of poor glazing techniques and a direct result of the following;

- The use of incompatible sealants, silicones and setting blocks.
- Moisture entering the glazing cavity and not being allowed to adequately drain away.
- Non-compliant installation in accordance with the relevant Australian Standards (refer AS 4666).

Replacement will be in accordance with the terms and conditions of the product warranty.

Condensation on the indoor face

Surface #2 for single glazed and surface #4 for double glazed are defined as the indoor faces of a glazed panel, refer to diagram 2.

Condensation that forms on the inside of a building is due to a combination of high internal humidity levels and colder outside temperatures. This combination cools the inside surface to below the dew point.

The NCC outlines 8 climate zones across the country. Internal condensation is more likely to occur in the cooler zones (4-7). However the warmer zones are not exempt from condensation as air conditioned spaces in the warmer months can cause condensation by cooling surfaces within the home.

The condensation will commonly form in the corners mainly due to frame effects of more conductive frame types e.g. aluminium, steel or even metallic spacers if incorporated within an IGU.

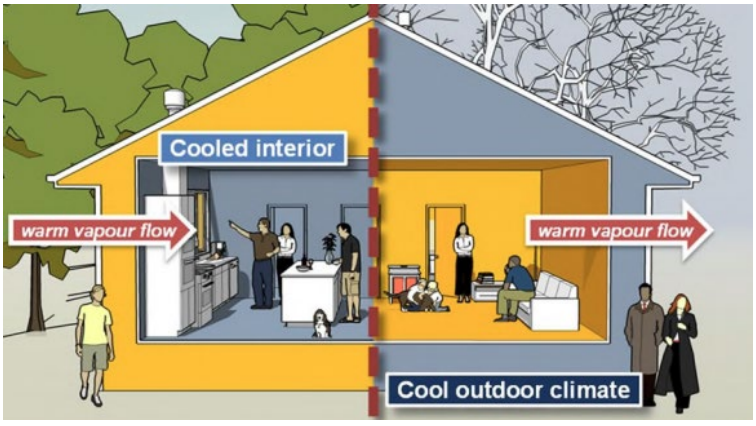
In addition, certain internal areas where humidity levels are high such as bathrooms and kitchens will be particularly susceptible to condensation.

To control this form of condensation, consideration should be given to improving the heating and ventilation, including exhaust fans for showers and cooktops.

The most effective method to reduce the internal condensation on glass surfaces throughout the building is to use double glazed units, especially those containing a Low E coating.

The double glazed unit reduces the rate of heat exchange across the airspace, this allows the internal surface of the glass to stay warmer, reducing the likelihood of condensation forming.

Diagram 3. Temperatures externally vs. internally



Other contributing factors

There are other contributing factors that increase the risk of condensation, including but not limited to the following.

Firstly, throughout the building and construction phase, large amounts of water are used when installing building materials such as concrete, plaster, grouting and tiles. As these materials dry, damp climates are temporarily created inside the building. During this time the risk of condensation may be abnormally high.

Secondly, localised humid spaces can be created where there is a confined space i.e. between a window covering and the glazing.

In these instances, the risk of condensation is increased.

3. SOLUTION

Condensation can be reduced by controlling the internal environment and material choices.

In relation to glass selection, the solution is an insulated glass unit with a Low E coating on surface #3, such as Viridian ClimaTech™, LightBridge™ or PerformaTech™. This will significantly reduce the risk of internal condensation and restrict the heat exchange across the air or gas cavity, keeping the inner pane warm and reducing the chance of condensation forming. Additionally, utilising a warm edge spacer within the IGU will further limit the risk of condensation forming around the frame and the edges of the unit.

Glass is only one component of a window system; consideration must be given to the window frame material and correct installation.

Viridian is a glass processor and do not claim to provide the following information as advice, please consult the relevant building experts.

Window frame materials impact how condensation forms. Aluminium is a common material choice for window frames, but is also an excellent conductor, meaning it can form a thermal bridge into your home and attract condensation on internal surfaces.

Thermally broken aluminium, uPVC or timber frames are options that can reduce this thermal bridge.

Specifying and installing building materials that have thermal properties capable of maintaining indoor surface temperatures above the dew point temperature should be considered. For example, building membranes, thermal bridging in frame structure, vented roof systems, vapour-permeable walls, air-tight walls, double glazing, thermally broken aluminium frames, or frames such as uPVC and timber.

4. CONCLUSION

Condensation is a climatic condition that is caused by water vapor changing back into a water form. Glass does not cause the condition but due to its inability to insulate against outside temperatures without adding an air or gas cavity i.e. double glazing, it is commonly the first material to exhibit condensation. Condensation cannot be eliminated but can be significantly reduced by double glazing.

5. APPENDIX

Vaisala. (2024). Dew Point Temperature: What Does It Mean and How Can It Be Calculated. Retrieved July 4, 2024, from https://www.vaisala.com/en/expert-article/dew-point-temperature-what-does-it-mean-and-how-can-it-be-calculated.

Australian Building Codes Board. (2023). *Condensation in buildings handbook*. Retrieved from https://www.abcb.gov.au/sites/default/files/resources/2023/Condensation-in-buildings-handbook.pdf