AIR, MOISTURE AND CONDENSATION

INTRODUCTION

Condensation can damage finishes and materials (e.g. by causing timber to rot) and be a health hazard by promoting mould growth. Moisture entry into buildings also increases air conditioning energy consumption. Higher R-Values and tighter building sealing increase condensation risk.

DEW POINT

Dew point is the temperature to which the air must be cooled for saturation to occur, saturation being the condition in which the air cannot hold any more water vapour.

CONDENSATION

Walls and roofs

The diagram shows notional temperature and dew point profiles across a wall in winter. Condensation occurs when the temperature of a surface at a location is below the dew point of the adjacent air. In the diagram, this occurs in the shaded region (X), part of which is within the insulation. This is not uncommon because most of the temperature difference occurs at the bulk insulation.

If vapour is not stopped, the insulation will become laden with condensed water. One method of controlling this is to provide a vapour barrier located on the more humid side, where the temperature profile is above the dew point profile. In the diagram the most convenient place is between the lining and insulation.

Preventing condensation is a complex design issue requiring careful design and detailing. Several factors including climate, construction details and building use, need to be analysed to determine the risk of condensation and the need for a vapour barrier. An inappropriately located vapour barrier may cause, rather than prevent, condensation problems.

Glazing

For single glazing, the temperature gradient is very steep with the inside surface at essentially the same temperature as the outside. This is why condensation is common on the inside face (warmer side) of single glazed windows in cold climates.

NCC PROVISIONS

BCA (2022) Volume One Part F8 and BCA (2022) Volume Two H4D9 contain specific provisions for condensation management applicable to Class 1, Class 2 and Class 4 buildings, including pliable building membranes, flow rate and discharge of exhaust systems, and ventilation of roof spaces. BCA F8D3 requires a vapour permeable membrane be used for climate zones 4, 5, 6, 7 and 8 where a pliable building membrane is installed in an external wall.

BCA Part J4 and BCA Part H6 contain requirements for thermal construction, nominating minimum Total R-Values for building elements.

VAPOUR CONTROL MEMBRANE (VCM)

Specifying VCMs

AS 4200.1 provides duty classifications for tensile strength, edge tear resistance and bursting strength ranging from Extra Light Duty to Extra Heavy Duty.

It also documents four VCM classifications: Class 1 and Class 2 as **vapour barriers**, and Class 3 and Class 4 as **vapour permeable membranes**.

Unless specifying a proprietary product, include both duty and VCM classification to AS 4200.1.

Installation is to AS 4200.2.To be effective, a VCM must be continuously sealed and correctly located.

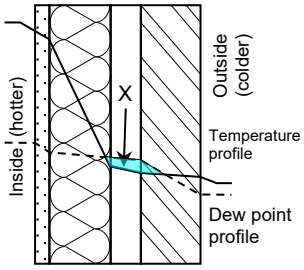
VCMs as insulation

Calculate Total R-Value for layers of different materials, air spaces or reflective surfaces to AS/NZS 4859.2.

If the reflective foil vapour control membrane faces an air space (at least 20 mm wide) it will also act as thermal insulation. If sandwiched between other layers, reflective foil offers no thermal advantage so cheaper vapour control membranes may be used.

Vapour permeable (breathable) membranes

Vapour permeable (breathable) membranes are essential in situations where liquid water (e.g. rain or condensation) must be stopped but water vapour must be released.
AS 4200.1 clause 5.3.4 contains VCM classifications with their corresponding vapour permeance in µg/N.s. Only Class 3 and Class 4 VCMs are vapour permeable (breathable) membranes.



This shows a wall with a higher air temperature inside than outside. The temperature profile (solid line) is below the dew point profile (dashed line) in the coloured region, X. When the surface temperature is below the dew point in this region, condensation is likely to form on surfaces within it.

The location of a VCM (if used) will depend on climate type (hot humid, hot arid, etc), whether the inside space is air conditioned, and, if so, patterns of operation.

Relevant standards

AS 3999 *Bulk thermal insulation - Installation*

AS 4200.1 *Pliable building membranes and underlays - Materials*

AS 4200.2 *Pliable building membranes and underlays - Installation*

AS/NZS 4859.1 *Thermal insulation materials for buildings - General criteria and technical provisions*

AS/NZS 4859.2 *Thermal insulation materials for buildings - Design*

Relevant documents

NCC (2022) H4D9 Class 1 and 10 buildings – Health and amenity – Condensation management

NCC (2022) H6 Class 1 and 10 buildings - Energy efficiency

NCC (2022) F8 Health and amenity – Condensation management

NCC(2022) Part J4 Energy efficiency – Building fabric

ABCB Handbook *Condensation in Buildings*

ASHRAE Handbook *Fundamentals*

AIRAH DA07 *Criteria for Moisture Control Design Analysis in Buildings*

AIRAH DA09 *Air conditioning load estimation and psychrometrics*

Relevant worksections

0331 Brick and block construction

0420 Roofing - combined

0430 Cladding - combined

0432 Curtain walls

0471 Thermal insulation and pliable membranes