The Building Envelope Authority

Guidance Documents

February 2022

GD 40 UNDERSTANDING MEMBRANES IN VENTILATED RAINSCREEN FACADES

1.0 INTRODUCTION

This guidance document takes a holistic approach to the key elements of design around airtightness, water ingress, condensation control (vapour permeability), and fire protection to achieve the optimum performance and long-term durability in ventilated rainscreen facades. The document covers the following subjects:

- Terminology of membranes including main functions.
- Membrane placement within the envelope, considering of both vapour permeable and vapour controlling membranes.
- Airtightness.
- Regulation - BS 5250 and Condensation Risk Analysis using Hygrothermal. assessment methods as per BS EN 13778 and BS EN 15026.
- Fire regulations and Approved Document B.
- Detailing / installation

2.0 TERMINOLOGY IN MEMBRANES INCLUDING MAIN FUNCTIONS

There are many different terminologies that are used in regard to membranes within the construction industry. An appreciation of the terminology will help the correct membrane to be specified in the appropriate position within the envelope, in accordance with its functionality.

Note: A vapour control layer (VCL) can sometimes be referred to as a vapour barrier or air and vapour control layer (AVCL): See BS 5250 definition:

3.1.3 air and vapour control layer (AVCL)

Continuous layer to restrict the movement of air and water vapour

This is a reasonably obvious terminology; here the membrane is used to control the amount of air and vapour moving from one area to the other. In the UK climate, where the common vapour drives are from inside to outside, the VCL is used on the warm side of the insulation. VCLs used to be referred to as the vapour barriers, but this terminology has been updated.

The term barrier implies an absolute which is not possible due to the fixing and detailing of the VCL. The new reference is commonly prefixed with an ‘A’ giving us an air and vapour control layer (AVCL)), where the membrane is forming a dual function of controlling vapour movement and limiting air movement, which enhances the building’s airtightness (see separate airtightness guidance in section 3).

A breather membrane has a vapour resistance lower than 0.12m Sd (0.6 MNs/g) but greater than 0.05m. See BS 5250 definition:

> **3.1.26 vapour permeable membrane**
>
> Membrane with water vapour resistance, s_d, less than 0.12m (0.6 MN·s/g) but greater than 0.05m (0.6 – 0.25 MN·s/g) used in walls, metal sheeted roofs and flat roof constructions.
>
> *NOTE 1 Also known as breather membrane.*
>
> *NOTE 2 When used in exposed locations, e.g., open rainscreen cladding, the membrane is expected to be UV-resistant (see 11.6.6).*
>
> *NOTE 3 Membranes for use in walls, metal sheeted roofs and flat roof construction are different from those vapour permeable membranes termed LR underlays used in slated and tiled pitched roofs (see 3.1.16) where the water vapour resistance, s_d of the membrane is no greater than 0.05m (0.25 MN·s/g).*
>
> *NOTE 4 Breather membrane requirements are different from those for LR underlays in pitched roofs (see 3.1.16)*

Sometimes referred to as a vapour permeable membrane or walling underlay; this definition is for walls and should not be confused with an LR (low resistance) underlay used in pitched roofing where the vapour resistance needs to be below 0.05 m Sd (0.25 MNs/g)

The term breather membrane is common in the industry. The more accurate description is a vapour permeable membrane, as the membrane is designed to let vapour permeate through it, as opposed to controlling it, like the VCL above. These membranes are traditionally placed externally of the insulation; but in a ventilated rainscreen can be positioned between the sheathing and cavity insulation.

The membrane is designed to protect the envelope from water ingress (rain) during construction and after, on open joint and perforated panels and allow vapour to escape to the outside, thereby reducing the risk of moisture build up during the building's lifetime. Depending on the physical properties, the membrane can be airtight, which adds to the building's airtightness (see Section 3 - airtightness)

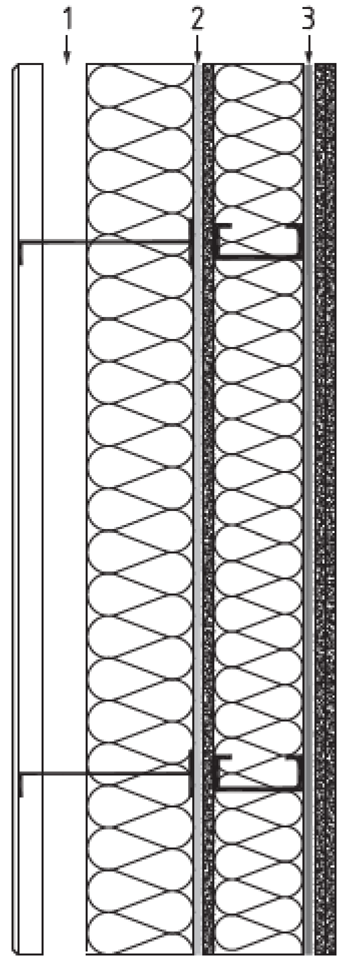
3.0 MEMBRANE PLACEMENT IN THE ENVELOPE OF BOTH VAPOUR PERMEABLE AND VAPOUR CONTROLLING MEMBRANES

The placement of the insulation along with its thermal performance and vapour permeability needs to be taken into account when designing the external envelope.

The following wall cross sections are taken from the recently published BS 5250. It shows the application of the airtight yet vapour permeable membrane (1) attached to the sheathing, with insulation placed between the SFS frame and within the cavity, externally to the membrane and sheathing.

The VCL (2) is described as optional, but this is only where a condensation risk analysis has proven that it may not be needed. In certain cases, it is advisable to have one as it will reduce the transfer of vapour through the external envelope.

Figure 38 — *Closed joint rainscreen cladding*



Key

1 Ventilated void

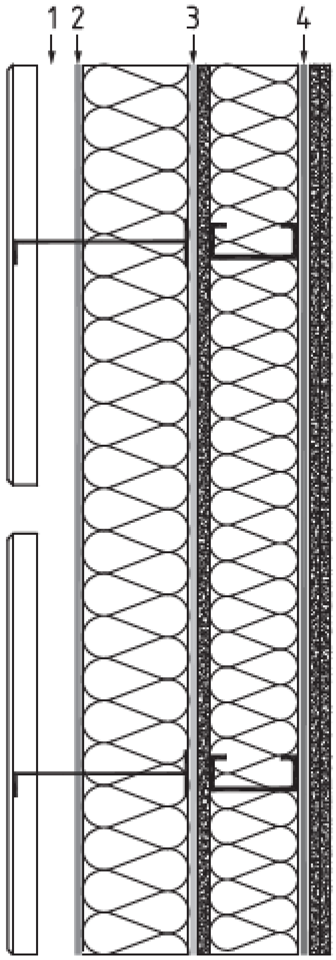
2 Airtight yet vapour-permeable membrane

3 AVCL optional

© BSI

The next detail shows how a breather membrane (1) can be utilised in open rainscreen applications along with the airtight yet vapour permeable membrane (2) and the optional VCL (3).

Figure 39 — *Open joint rainscreen cladding*



Key

1 Ventilated void

2 Breather membrane with 5 000 h

3 Airtight yet vapour-permeable membrane

4 AVCL optional

The following is text from BS 5250 which explains further the membrane behind open cladding:

> Where the rainscreen is particularly open to UV radiation (as shown in Figure 39), a UV-resistant membrane should be used. This should achieve class W1 resistance to water penetration after exposure to 5000h of UV ageing in accordance with BS EN 13859-2. It should have an s_d value of not greater than 0.25m. If the s_d value is greater than 0.12m then a condensation risk analysis should be carried out to check that there is no build-up of moisture due to interstitial condensation.

4.0 AIRTIGHTNESS

The strive for good airtightness is a driving force for good thermal efficiency and can be utilised to meet the evolving legislative requirements. It adds to the functionality of the building's envelope as well as providing good moisture management, when designed correctly.

A number of methods can be used to meet lower airtightness values, traditionally this is done by the utilisation of a vapour control layer, hence the term AVCL (Air and Vapour Control Layer).

The vapour control layer installation, jointing and detailing, is critical to achieving a good airtightness result. Care and attention should be taken to ensure continuity of the membrane, with the laps well sealed with appropriate tapes.

Care should be taken to mitigate potential damage by follow on trades e.g., electrical and plumbing services etc. A good way of minimising these issues is to utilise a service cavity for pipes and cables.

An alternative method is to use an airtight 'breather membrane' on the outside of the sheathing. This can reduce the risk of damage from follow-on trades and make installation more robust due to fewer penetrations. This layer can be mechanically fixed and / or taped to the sheathing board.

When taking the construction height into consideration, the level of wind movement maybe much greater, this can place additional strain on the mechanically fastened or taped membranes. These increased wind loads may result in excessive movement of the membrane which can lead to them being damaged and ultimately can result in extensive remediation.

The utilisation of a fully self-adhered, air tight, yet vapour permeable layer can be bonded to the sheathing board and this can be useful in avoiding extraneous fixings through the membrane that may lead to water ingress. A fully self-adhered membrane will reduce and nullify airgaps behind the membrane, limiting the detrimental effects of thermal bypass with potential fire benefits (see Clause 5 below).

Depending on the position and thickness of the insulation, when using a fully adhered membrane as your airtightness line, it may be possible to limit the requirement of the VCL. Caution needs to be taken and should be shown with an appropriate condensation risk analysis.

5.0 REGULATION - BS 5250, HYGROTHERMAL ASSESSMENT METHODS BS EN 13778 AND BS EN 15026

BS 5250 is the British Standard that looks at Moisture Management in Buildings (formerly known as *Code of Practice for the Control of Condensation in Buildings*) - the standard now refers to a more holistic approach to controlling moisture including the potential for rain penetration.

In terms of condensation analysis there are two main methods of calculating the risk described in BS 5250. Both can be utilised and the following is a summary of the two methods -

5.1 The Glaser method BS EN 13788

The traditional method of assessing condensation risks in buildings is the Glaser method – a static moisture movement calculation. The Glaser approach is a simplified method of assessing lightweight constructions however, it assumes water vapour only moves in one direction and it ignores the effects of precipitation and convection.

The Glaser calculations can be an effective tool to assess risk; however, it can be limited by looking at moisture movement purely by diffusion and does not consider the storage of heat or moisture. The Glaser calculations do not consider built-in moisture or absorption of driving rain.

5.2 Hygrothermal assessment to BS EN 15026

Hygrothermal assessments, such as provided by WUFI®, can go into more detail than the Glaser method.

Dynamic hygrothermal software provides an assessment based upon the analysis of heat and moisture transfer through elements of a building.

The data obtained from a hygrothermal assessment can provide an accurate measurement of the temperature, relative humidity, and water content within the elements of a building measured over a specified time.

These simulations help to analyse different construction assemblies in various climates globally and determine the risk of interstitial condensation. This could lead to the risk of mould growth and timber rot in associative building materials, and also allows the assessor to consider methods to reduce these issues.

Software such as WUFI® is fully compatible with BS EN 15026, and dynamically predicts moisture movement and storage as well as condensation for each location. The designer can achieve a minute-by-minute prediction over a given period of years. The programme can consider a worst-case scenario, with the ability to inject moisture leaks at source which can enable the assessor to analyse the robustness of the design and efficiency of the drying out of the element.

A further benefit of using the hygrothermal assessment is that specific climatic conditions, including temperature, precipitation and prevailing weather conditions are considered. The colour of the external cladding can make a difference through solar radiation and can be modelled. These factors, along with others, are important when assessing the robustness and correct positioning of the membranes, to ensure a healthy building fabric.

6.0 MEMBRANE PERFORMANCE: FIRE REGULATIONS & APPROVED DOCUMENT B

Fire regulations are a critical requirement with any building, but especially high-rise façade design.

6.1 Reaction to Fire

This is considered under Part B of the Building Regulations. It considers the contribution of material and building elements to fire growth, particularly at early stages when evacuation is key. BS EN 1350-1 categorises them using European classification A-F

For Class A2-D, this is then preceded by a smoke emissions rating s1-3. s1 being better than s2 which is better than s3. Then finally a flaming droplet index d0-d2. d0 being non-dripping, up to d2 being high dripping.

6.2 Fire resistance

This is usually attributed to a material's ability to resist the effects of fire usually expressed in duration of time from one area to another.

Approved Document B 2006 and amendment relates to buildings over 18 metres and stipulates what can be included or excluded, to enable a facade design to be classified as non-combustible or combustible.

Changes applicable from December 2018 consider membranes over 18 metres more specifically, and state that membranes must have a minimum Class B, s3, d0 classification to be used on constructions over 18 metres.

7.0 DETAILING / INSTALLATION

Design teams are encouraged to engage with membrane manufacturers at an early stage to look at overall design and specific detailing. Standards of workmanship are key and regular inspections are recommended.

Before work commences the substrate should be assessed to ensure it is dry, free from dust, laitance, release agents or other bond breaking contaminants and potential surface irregularities.

Membranes should be installed as per the manufacturer's guidance and third-party accreditation, with adequate laps, shingle effect where required, especially on externally applied membranes, and appropriate tapes and sealants used.

MCRMA member companies provide a wide range of building envelope solutions for metal-based roofing and cladding products and services and they can advise on the suitability and performance of materials, systems and assemblies.

Manufacturers are best placed to offer advice about their particular products and any variation from their published data during the design or construction process could result in the component or system failing prematurely or not complying with the guarantee or warranty conditions. In addition, design information can be obtained from any of the independent roofing and cladding inspectors featured on the MCRMA web site.

REFERENCES

Approved Document B (fire safety) volume 1: *Dwellings, 2019 edition incorporating 2020 amendments*

Approved Document B (fire safety) volume 2: *Buildings other than dwellings, 2019 edition incorporating 2020 amendments*

BS EN 1350-1: 2018 *Fire classification of construction products and building elements – classification using data from reaction to fire tests*

BS 5250: 2021 *Management of moisture in buildings – Code of practice*

BS EN 15026: 2007 *Hygrothermal performance of building components and building elements. Assessment of moisture transfer by numerical simulation*

BS EN ISO 13788: 2012 *Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods (ISO 13788:2012)*

NOTE:

Every effort has been made to trace the rights holders and to obtain their permission for the use of copyright material. If there are any errors or omissions in the acknowledgements and credits, we would be grateful for notification of any corrections that should be incorporated in a future edition of this guidance document.

DISCLAIMER

Whilst the information contained in this publication is believed to be correct at the time of publication, the Metal Cladding and Roofing Manufacturers Association Limited and its member companies cannot be held responsible for any errors or inaccuracies and, in particular, the specification for any application must be checked with the individual manufacturer concerned for a given installation.

Information provided by the MCRMA or contained within publications and articles which are made available in any form (mechanical, electronic, photocopying or otherwise) cannot be used or cited as a means of ensuring that a material, product, system or assembly is compliant with Building Regulations.