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Breather membranes for timber frame walls

All timber frame walls are designed to 'breathe'. The term 'breathe' refers to the ability of a wall to allow water vapour to diffuse through the structure. This is an important consideration to the long term durability of the timber structure.

A breather membrane restricts the passage of liquid water, whilst allowing water vapour to pass through.

This Wood Information Sheet (WIS) is an overview of the subject with signposts to more detailed sources that are listed at the end.

Contents

Figure 1: DuPont™ Tyvek® Reflex advanced breather membrane used in residential project in Burwell, UK.
Photo: DuPont™ Tyvek®, all rights reserved.

Key points

- Breather membranes need to combine a high degree of wet strength and water resistance with very low moisture vapour resistance.
- There are a number of different types of breather membrane that may be used in timber frame construction. These membrane offer varying properties, such as thermal resistance, moisture vapour resistance, resistance to water penetration and resistance to tearing.
- Air infiltration through gaps in the building fabric can accelerate the rate of heat loss due to convection. The breather membrane can mitigate this heat loss, provided laps are sealed with a proprietary self-adhesive tape.

Requirements

The breather membrane performs a number of functions in a timber frame wall:

- It protects the fabric of the building from rainwater penetration during construction before external claddings are completed.
- It provides a second line of defence against water penetration during the life of the building as most claddings act as rainscreens, rather than as complete barriers.
- It allows water vapour to escape from the construction.
- It can also contribute to air sealing the wall and reducing ventilation heat losses and wind washing through insulation layers. This aspect is of increasing importance as air leakage is now an important part of the thermal performance requirements under building regulations.
- It should be lapped and detailed to deflect water away from the timber frame, e.g. at cavity barriers, cavity trays, window openings etc.

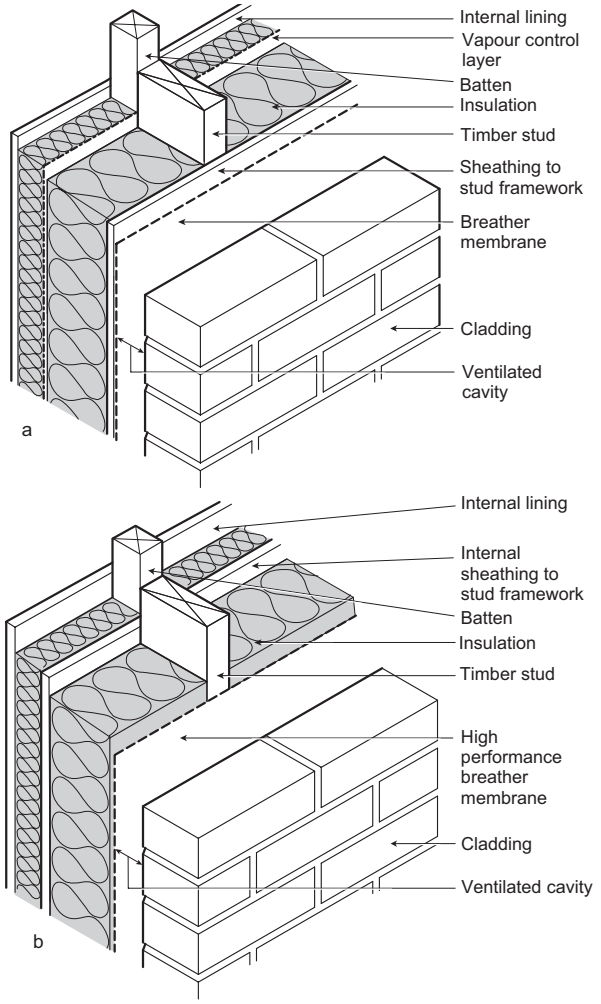


Figure 2: Typical wall construction with insulated service zone on inside face containing additional insulation:
a. Conventional wall design has sheathing on external face of frame;
b. Reverse wall design has sheathing on internal face of frame.

A breather membrane is required to protect timber frame walls:

- where the outer sheathing of a conventional timber frame wall is oriented strand board, plywood or certain types of medium board – this is the usual method in the UK
- where the sheathing is on the inner face of the wall, so-called 'reverse wall' construction
- where additional layers of insulation are installed over the outer face of the timber frame structure

Specification

Breather membranes need to combine a high degree of wet strength and water resistance with very low vapour resistance. In summary breather membranes need to be:

- water resistant
- permeable to water vapour
- tear resistant.

BS EN 13859-2 Flexible sheets for waterproofing. Definitions and characteristics of underlays. Underlays for walls [1] replaces *BS 4016:1997. Specification for flexible building membranes (breather type)* [2] which has now been withdrawn. Nevertheless there are some aspects of *BS 4016* that remain useful for designers.

This new standard does not contain performance requirements for the breathability of the breather membranes and only reference test standards with no specific performance requirements. It is important when conducting condensation risk calculations that the exact materials that are to be used in the wall build up are used in the model. Obtain manufacturer's test data for these calculations.

TRADA Technology recommends that designers follow *BS4016* regarding moisture vapour resistivity of breather membranes for walls. Deviation for this moisture vapour resistance performance is permitted only if interstitial condensation risks are assessed using specific material properties and the results are favourable.

In *BS EN 13859-2* there are three classifications for water penetration – W1, W2 and W3 – where W1 is the best. TRADA Technology recommends the use of breather membranes of at least Class W2 for timber frame external walls. In areas of high exposure, or where liquid water penetration of the cladding is anticipated, use a breather membrane of Class W1.

BS 4016 contains methods for determining the level of performance and minimum performance requirements. There are three types of breather membrane listed in BS 4016 – types 1, 2 and 3.

Table 1: Minimum performance requirements

Characteristic	Type and test level		
	Type 1	Type 2	Type 3
Water penetration resistance (mm)	100	100	95
Maximum water vapour transmission resistance (MNs/g)	0.6	0.6	0.6
Minimum tear resistance in any direction (N) – dry	20	10	20
Minimum tear resistance in any direction (N) – wet	20	none	20

For all wall designs where breather membranes are still rated using *BS 4016*, TRADA Technology recommends Type 1 membranes due to their superior resistance to water penetration and tearing.

Condensation risk

There are two types of condensation – surface and interstitial (within the wall structure).

Surface condensation is visible to and largely generated by the actions of occupants. The risk of surface condensation is also increased with the presence of thermal bridging (e.g. at junctions between elements). NHBC guidance note *Condensation in homes* [3] explains how to control surface condensation.

Interstitial condensation is condensation that occurs within the structure of wall (or roof or floor). There is a rule of thumb to ensure that interstitial condensation cannot occur – the vapour resistance of the layers on the warm side of the insulation should be at least five times that of those on the cold side. This controls the flow of water vapour by ensuring that it escapes more quickly through the outer layers of the wall than it can enter through the inner layers.

The conventional timber frame wall design comprises (starting on the inside):

- plasterboard
- a service void may be present containing additional insulation
- vapour control layer
- solid timber studs with insulation between
- oriented strand board (OSB) sheathing
- breather membrane
- drained and vented cavity
- external cladding.

The presence of an imperforate vapour control layer, on the warm side of the insulation, ensures that there is no risk of interstitial condensation.

BS 5250 Code of practice for control of condensation in buildings [4] contains methods for calculating condensation risk and recommendations for condensation control. Designers use computer software to make the calculations.

The breather membrane is required to have a moisture vapour resistance that is sufficiently low to ensure that there is no risk of condensation.

Installation

Breather membranes may be applied to wall panels on site or in the factory. If membranes are factory fitted, they must have sufficient tear resistance and be fixed well enough to ensure that the membrane is not damaged during transportation and erection of the panels.

Once the building is erected, the cladding should be installed reasonably quickly as many types of breather membrane can degrade with exposure to UV radiation. Reflective breather membranes as well as membrane designed for use behind open jointed cladding are more robust to exposure to sunlight. Check the manufacturer's recommendations.

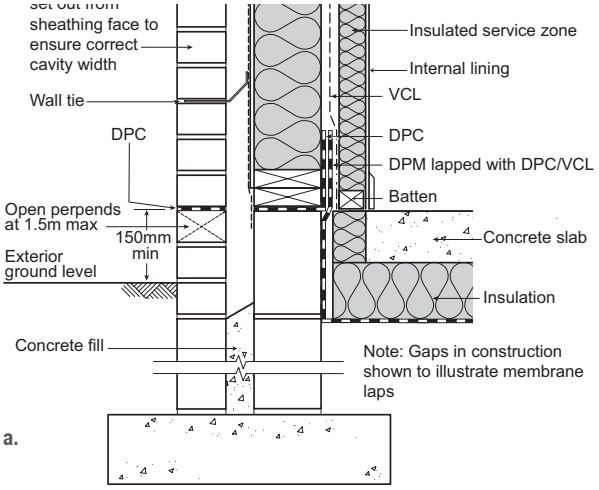
Extent and overlaps

Apply breather membranes from 25mm below the lowest timber member, usually the sole plate. If excess membrane has been provided, it should be trimmed off leaving a 25mm lap to ensure that it does not bunch up in the external wall cavity. Contact with moisture in the base of the cavity may result in it wicking up the breather membrane and coming into contact with structural timber components.

Apply the membrane in horizontal layers from the bottom up so that the upper membrane overlaps the lower. Lap membranes at least 100mm horizontally and 150mm vertically. Stagger vertical joints by at least 300mm, where possible. Breather membrane laps at corners should be sufficiently long to cover the end of the adjoining panel, and lap 150mm over the adjacent breather membrane.

In 'reverse wall' construction *(Figure 2b)*, take care to ensure that the insulation is no thicker than the depth of the studs, unless rigid boards are to be installed to the outer face of the studs. This will avoid undue pressure being applied to the breather membrane

and its fixings. Where possible, fix horizontal laps to solid timber rails or noggings to aid air sealing. Alternatively, seal the lap with a proprietary self-adhesive tape.



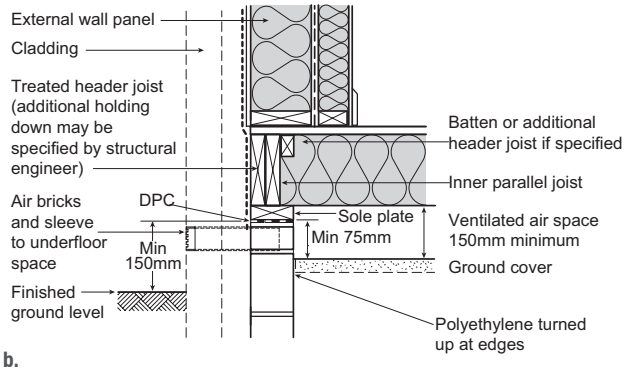


Figure 3: Overlap at sole plate or bottom rail:
a. Concrete ground floor,
b. Timber ground floor

Breather membranes should also cover the intermediate floor zone. Where membranes are applied to panels in the factory, follow *Table 2* for fixing centres, as well as at the sides, head and base of each panel. Extend the membrane beyond the sides and base of panels to meet the lap requirements shown in *Figures 3 and 4*. Extend the membrane at the base of upper storey panels sufficiently to cover the intermediate floor zone and provide 100mm lap over the lower panel. Alternatively a separate breather membrane skirt can be installed around the floor zone. Fix the lap sections back to the panels temporarily for transport.

Lap breather membranes over the damp proof course (DPC) at heads of openings and under the DPCs at jambs and sills. A pre-fixed membrane may be slit to allow the DPC to be tucked in behind.

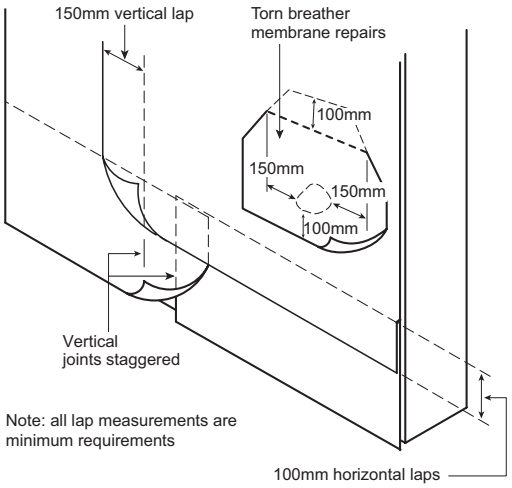


Figure 4: Horizontal and vertical laps, and repair.

Lap breather membranes over DPCs at horizontal cavity barriers, except at eaves and verges.

For additional moisture protection around window and door openings, fold the membrane the breather membrane over and inwards to cover all timbers. Seal corners with a proprietary self-adhesive tape.

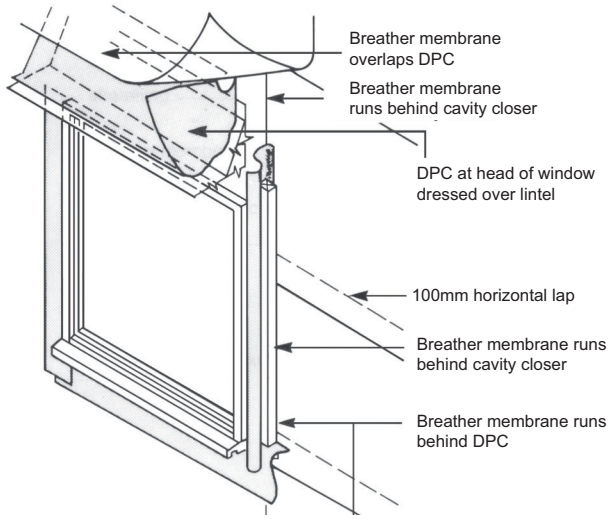


Figure 5: Breather membranes around openings

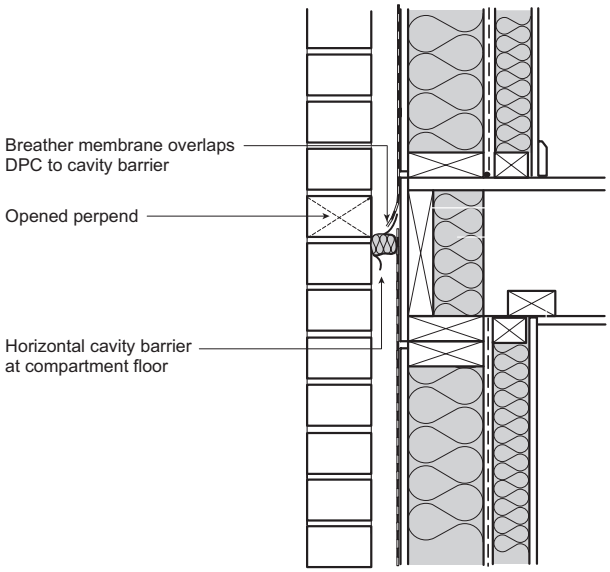


Figure 6: Breather membranes at cavity barriers

Fixings

Fix breather membranes with austenitic stainless steel staples or nails, spaced as shown in *Table 2*.

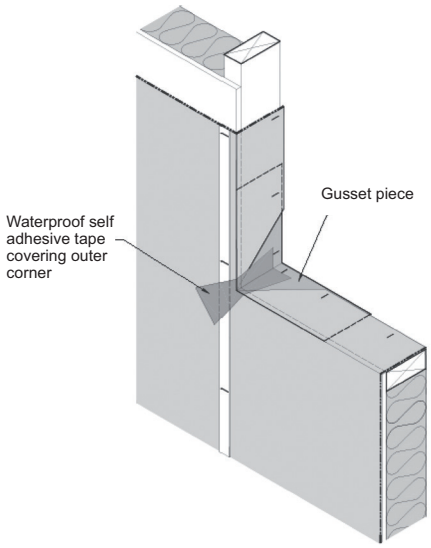


Figure 7: Breather membrane folded in around window opening.

Make fixings at stud positions through PVC banding tape. This provides additional tear resistance and marks the stud position for fixing wall ties on site. It is essential to use tape in the very severe exposure locations. If another system of marking is used it should be clear, indelible, and fade and tear resistant.

Table 2: Fixing of breather membranes.

Vertical	Fixing centres (mm)
at stud positions	300
at sides of openings	150
at vertical membrane joints	150
at end of panel*	150
Horizontal	
at eaves	150
at sole plate or bottom rail	150
at horizontal membrane joint	150
at head and base of openings	150
at head and base of panels *	150

* required when membrane is fixed to panels in the factory

Air infiltration

Air infiltration becomes more significant as thermal performance increases. Gaps in the building fabric can accelerate the rate of heat loss due to convection. The breather membrane can help mitigate this heat loss, provided laps are sealed with a proprietary self-adhesive tape. Follow the breather membrane manufacturer's instructions to minimise air infiltration.

Repair

Repair or replace any damaged membrane (see *Figure 4*), ensuring that the laps are maintained and that the upper sheet laps over the lower.

When repairing a torn breather membrane:

- Cut a horizontal slot above the tear to extend 150mm beyond the outermost edges of the tear.
- Cut a breather membrane patch to fit between the outer edges of the horizontal slot and to extend 100mm below the tear and 100mm above the horizontal slot.
- Slide the breather membrane patch through the horizontal slot so that the patch area above the slot is on the sheathing side of the torn breather membrane and the remaining patch membrane covers the tear and is on the cavity side of the tear.
- Fix the patch with stainless steel staples. If the building is in a 'very severe' exposure zone, seal the slot with a proprietary self-adhesive tape approved by the breather membrane manufacturer.
- Fix additional stud indicator tape as required.

References

1. BS EN 13859-2:2010. Flexible sheets for waterproofing. Definitions and characteristics of underlays. Underlays for walls, BSI
2. BS 4016:1997 Specification for flexible building membranes (breather type), BSI
3. Guidance note: Condensation in homes, NHBC, 2011, available at www.nhbc.co.uk
4. BS 5250:2011 Code of practice for control of condensation in buildings, BSI

Further reading

Lancashire, R. and Taylor, L., Innovative timber construction. New ways to achieve energy efficiency, ISBN 978-1900510875, TRADA Technology, 2012

Lancashire, R. and Taylor, L., Site manager's pocket guide to timber frame, ISBN 978-1900510653, TRADA Technology, 2009

Lancashire, R. and Taylor, L., Timber frame construction, 5th edition, ISBN 978-1900510820, TRADA Technology, 2011

Pitts, G. and Lancashire, R., Low-energy timber frame buildings: designing for high performance, 2nd edition, ISBN 978-1900510806, TRADA Technology, 2011

WIS 0-10: Surveys of timber frame houses, TRADA Technology, 2011

WIS 0-3: Introduction to timber frame construction, TRADA Technology, 2012

WIS 0-5: Timber frame building – materials specification, TRADA Technology, 2006

About TRADA

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and not-for-profit membership-based organisation. TRADA's origins go back over 75 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

Our aim

To provide members with the highest quality information on timber and wood products to enable them to maximise the benefits that timber can provide.

What we do

We seek to achieve this aim through active and on-going programmes of information and research. Information is provided through our website, an extensive collection of printed materials and our training courses.

Research is largely driven by the desire to update and improve our information so that it continues to meet our members' needs in the future.

TRADA Technology is contracted by the Timber Research and Development Association to prepare and publish all Wood Information Sheets.

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