

Breathable roof tile underlays in cold roofs

Breathable membranes have been used in buildings for many years now and, more recently, in cold pitched roof constructions without traditional eaves ventilation. The benefit of reduced heat loss and not having to incorporate ventilators has seen their use grow but at the same time has attracted noticeable comment both from supporters of the application and from detractors who favour traditional ventilation solutions.

In light of this, the BBA has prepared this short article to clarify our view as independent assessors of 'fitness for purpose' of products and their application.

We have adopted a 'Question and Answer' approach to allow the easy identification of items of particular interest and/or concern to readers.

The views expressed here are based only on the BBA's experience in assessing breathable membranes in a number of applications over recent years. Products or applications which are outside the scope of published Agreement Certificates or national Codes of Practice have not been assessed by the BBA and are not addressed in this article.

Q1 What is a breather membrane and how does it work ?

A1 The particular membranes in question typically comprise spunbonded polypropylene or polyethylene laminated either side of a micro-porous polypropylene or polyethylene film. Monolithic spunbonded membranes are also used. They have a structure that is sufficiently fine to prevent liquid water penetration in service conditions, but not too fine to prevent the transfer of water vapour (molecules of water in air), see figure 1.

All materials, including vapour control layers, have a finite permeability to water vapour transfer however, in the context of this Article, a breather membrane is a material which, in service conditions, is sufficiently permeable to water vapour transfer to adequately limit the risk of condensation in roofs.

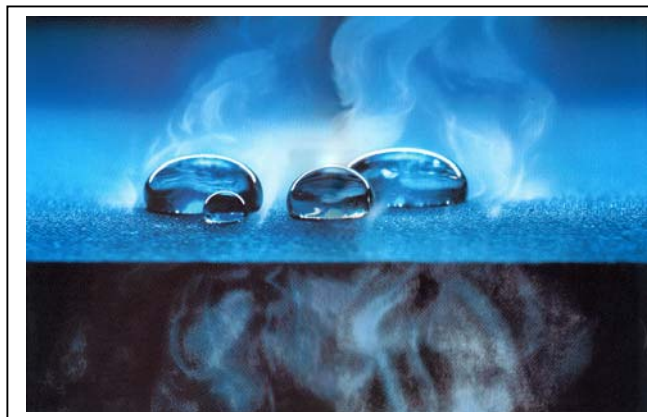
Current published definitions include the following:

BS 5250: 2002 section 3.2 "Breather membrane" – vapour permeable membrane with a vapour resistance less than 0.6 MNs/g

BS 5250: 2002 section 3.26 "Vapour permeable underlay" – Pitched roof underlay which meets the recommendations of BS 5534-1 and NFRC TB6 and is additionally water vapour permeable with a vapour resistance of less than 0.25 MNs/g

These two figures can also be expressed as water vapour transmission rates of at least 341 or 820 g/m²/day respectively, when tested under standard conditions of 23°C and humidity of 0% rh and 75% rh on each side of the membrane.

Figure 1 – Breather membrane



The function of the membranes is to provide all of the normal demands made on a roof tile underlay and at the same time allow water vapour egress without making specific provision for ventilation. See also Q/A3.

Q2 How widely are they used and in what applications ?

A2 Breather membranes have been used abroad in construction since the 1970's. Membranes were first Certified by the BBA in 1982 as sheathing membranes for timber frame walls and as roof tile underlays in conventionally ventilated cold roofs. They were subsequently approved as roof tile underlays in warm roof constructions in 1982 and most recently in cold non ventilated roof constructions in 1999. At the time of writing this article, Certificates for roof tile underlays used as part of a cold unventilated pitched roof system in dwellings have been issued as shown in Table 1

Table 1 – BBA Certificates issued for cold unventilated roof applications (at 15.03.04)

Certificate No.	Product name	Certificate holder
99/3648	Daltex Roofshield	Don & Low Ltd Nonwovens
00/3749	Permo Forte	Klober Ltd
01/3842	Global Breather Roof Tile Underlay	EBC UK Ltd
03/4017	Breathline Vapour permeable Underlay	Knauf Insulation Ltd
03/4062	Monarperm 700	Icopal Ltd
04/4078 - DS3	VapR-free underlay	Mercury Building products Ltd
04/4101	Tyvek Solid Underlay	DuPont de Nemours (Luxembourg) Sarl

Details of approved products can be found on www.bbacerts.co.uk or by phoning the BBA hotline on 01923 665400. Users are advised to check the validity of Certificates and any limitations on the scope of the approval.

Q3 Can they be used simply 'instead' of conventional eaves ventilation ?

A3 Only if a number of measures are taken to limit the ingress of water vapour into the unventilated space. In this regard, the roof system must be considered as a whole from ceiling to roof tiles, including the following design points:

- all penetrations into the roof space must be properly sealed
- loft hatches must incorporate effective compressible draught seals
- the rooms below the ceiling must include provision for the dispersal and rapid dilution of water vapour in accordance with the Building Regulations, including extractor fans in rooms that may experience high humidity
- All water tanks in the loft space must be covered
- Any vent pipes should be arranged so that they do not discharge water vapour into the loft space

See also Q&A10 to 15 and the relevant BBA Certificate for conditions of approval.

Q4 What are the advantages of using the unventilated system ?

A4 One of the main advantages is reducing the amount of heat lost by air leakage through the ceiling and from the loft space to the outside. Up to 25% of the heat lost through a conventional roof system is by this mechanism. The unventilated roof 'system' will reduce this mechanism of heat loss, even more so if the underlay laps are sealed. In addition, not having to provide eaves and ridge ventilation can help to save time and cost on site and can give a more desirable appearance to the finished roof.

Q5 What are the disadvantages of using the system ?

A5 Extra time and care is needed to ensure that the ceiling is relatively airtight and that the loft space is protected from sources of water vapour, in accordance with the requirements of the Certificate. See also A3.

If the ceiling is constructed without due attention to sealing joints and around penetrations, the opportunity for moisture ingress into the loft space and consequent risk of condensation occurring is increased. This is also true of conventionally ventilated constructions where the effect of wind movement over the roof can reduce the air pressure in the loft space and 'suck' moisture laden warm air from the living space into the loft space. However it is recognised that the rate of moisture removal via the ventilated and unventilated approach is not the same. It is therefore important that the ceiling is sealed to an appropriate level. BBA computer modelling of the behaviour of roofs has assumed effective ceiling 'defect' areas of up to 10 square mm per square metre of ceiling. See also Q/A 6, 7 and 11. There are reports concerning 'flapping-noise' in roofs incorporating permeable roof tile underlay membranes in certain wind conditions. The BBA has however only received a very limited number of reports in this regard and therefore do not view it as a fundamental problem.

Q6 How did the BBA assess the products in unventilated roof applications ?

A6 The suitability of the membranes as conventional roof tile underlays had already been established by means of conventional assessment and test programmes. The absence of conventional ventilation at eaves added the 'new' dimension which the BBA addressed by developing, in partnership with membrane manufacturers and suppliers, a sophisticated software package. This program used classical physics to model the dynamic movement of vapour in various roof constructions with a range of properties/parameters such as;

- internal and external humidities and temperatures
- vapour permeability of the roof tile underlay
- vapour resistances and defect areas for all layers in the ceiling and roof fabric
- wind velocity over the roof

The modelling indicates that the magnitude of the following parameters are of particular importance:

- permeability of the roof tile underlay
- rate of vapour passing through ceiling

Q7 Are the installation measures in Q&A3 practical to achieve ?

A7 Yes. The BBA has conducted a number of visits to sites in progress and completed buildings. See also Q&A6

Q8 BS 5250 : 2002 says that you have to ventilate ?

A8 Section 8.4.4.2 of the BS does state that pitched cold roofs with unsupported vapour permeable roof tile underlays do not require ventilation to the loft space, but a ventilated counterbatten space should be provided above the membrane, by means of eaves and ridge ventilation. Regulations, such as Requirement F2 *Condensation in roofs* to the Building regulations 2000 (as amended) (England and Wales) are mandatory and call for 'adequate provision to be made for preventing excessive condensation in roof spaces'. Meeting this Requirement can be demonstrated by following the guidance in the BS but it doesn't have to be followed if other means can be used to show compliance. The BBA assessment is for a roof 'system' and provided that the installation is in accordance with the requirements of the relevant Certificate, the mandatory requirements, ie the Regulation, will be met. See also Q&A3

Q9 How durable are the membranes/system ?

A9 In normal conditions found in roofs, the membranes are physically durable and can be expected to have a life comparable to that of traditional roof tile underlays. Specifiers should however follow the requirements of the relevant Certificate relating to the period for which the underlay can be exposed to the elements before slating/tiling and on the use of eaves guards for open eaves constructions. With regard to water vapour permeability, the BBA assessment included measurements of the effect of heat ageing, effect of UV light exposure and of accelerated dust/debris accumulation and found no discernible reduction in performance.

- Q10 Do I need a vapour check ceiling ?*
- A10 No but it can help. It is important to remember that vapour will pass through the path of least resistance in a ceiling. Gaps and cracks will provide an effective 'short-circuit' however high the vapour resistance of the rest of the ceiling is.
- Q11 What do I do about sources of moisture in the loft space*
- A11 Water tanks should have lids on and vent pipes arranged to avoid venting moisture into the loft space.
- Q12 Do I need counter battens ?*
- A12 In general, counter battens are not applied if the underlay is draped between rafters, ie a nominal 10 mm. If however it is not draped but pulled taut, counter battens are applied. Readers should refer to specific Certificates for the holder's detailed installation instructions.
- Q13 Can you have unventilated loft spaces when timber sarking is used ?*
- A13 Yes, with the traditional Scottish practice of planks nominally 100 mm wide with a 2 mm gap either side. Their use with large OSB or plywood timber panels, 2440 mm by 1220 mm, has not been approved by the BBA.
- Q14 Does the membrane have to run parallel to eaves or perpendicular (eaves to eaves via ridge)?*
- A14 Traditionally, roof tile underlays are laid in runs parallel to the eaves with subsequent runs 'weather lapped' by 150 mm. Some Certificate holders have had an alternative approach also assessed, where the underlay is drawn from the eaves, over the ridge and back down to the eaves on the opposite side of the building. This entails the use of a device to hold the roll of underlay horizontally and allow it to be unwound. Counterbattens are also needed to secure laps between adjacent runs of the underlay. Users should refer to the relevant Agreement Certificate for full details of this alternative method of installation.
- Q15 What type of roof covering can be used ?*
- A15 The issued Certificates cover conventional slates and tiles installed to the relevant clauses of BS 5534-1: 1997. The modelling assessments referred to in A6 included tightly fitting synthetic tiles with 'open' areas down to 475 mm² per square metre and predicted some slightly longer durations for condensation events, but at levels and durations that were still acceptable. When considering tightly fitting tiles and slates, specifiers are advised to check with the tile or slate manufacturer in case they have particular design requirements, for example a ventilated space beneath them.
- Q16 What happens to 'constructional moisture' ?*
- A16 The amount of constructional moisture present in a building depends on the materials used and type of construction. The risk of condensation is however greatest when there is significant drying out taking place. This may in some circumstances lead to condensation during the first heating season, but should not persist into a second heating season in a properly designed and constructed roof.
- Q17 What happens if the system is not installed properly or there is a condensation problem ?*
- A17 Whether a product or system is innovative or not, things can go wrong. In the first instance you should contact the installer or the Certificate holder. If the issue is not resolved satisfactorily, contact the BBA.

Q18 Has the BBA received any complaints about these types of systems ?

A18 Yes, three have been reported. One complainant did not reply to requests for fuller details of the failure, the other two are currently under investigation.
It is always important to bear in mind that very little building technology is immune to poor workmanship or inappropriate design. The question is often one of robustness and education. It is also important to note that even established solutions can sometimes fail

Q19 Is it better to ventilate or not ventilate ?

A19 Both approaches work although particular building types and constructions may favour one approach over the other.

Conclusions

The principle of designing and building a roof system that does not include traditional eaves ventilation is sound and practicable, provided that the design and installation instructions described in the relevant BBA Certificate are observed.

The BBA has not seen any evidence that suggests that such systems will not adequately limit the risk of damaging condensation.

Note, the BBA is an independent Approval and Certification body for construction products and systems.