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BS 5250: 2011
CONTROL OF CONDENSATION IN BUILDINGS.

ROOF VENTILATION EXPLAINED

Fairford Roof Tiles Ltd

THE NEED FOR CONDENSATION CONTROL

Condensation in roof spaces

A number of factors in modern constructions have led to increased risks of condensation within roof spaces:

- Fortuitous natural ventilation within buildings has been reduced by the use of high-performance draught-proof doors and windows and the blockage or elimination of open-flued chimneys.
- Modern lifestyles generate higher amounts of water vapour.
- Average air temperatures within buildings have increased, thereby allowing more water vapour to be carried in the air.
- Increased amounts of insulation at ceiling level have led to colder roof voids.
- The widespread use of roofing underlays has greatly reduced the amount of natural ventilation of the roof space.
- The use of vapour permeable (type LR) underlays, often with sealed laps and with no loft ventilation at all.

Research has shown that about 20% of the air that enters a building, and in particular dwellings, leaves via the roof with an additional moisture load, and that typically 80% of any water vapour transported into the roof is by air motions (convection) through the ceiling via gaps and cracks.

Condensation in the roof, taking place out of sight of the occupier, can cause serious damage, including severe structural weakening by wet or dry rot, loss of effectiveness of insulation, and damage to decoration through staining and mould growth.

What causes condensation?

Warm air can hold more water vapour than cold air. Condensation begins when air temperature drops to the dew point, or when warm moist air comes into contact with a cold surface. Water vapour can pass through most building materials including brick, concrete, plaster and plasterboard (unlined), wood and insulation. Warm air from within the building, carrying water vapour, can pass through ceilings into roof spaces. Since the roof space is likely to be colder, condensation will occur as soon as the air meets a cold surface; this is termed the 'wetting-out phase'.

Building regulations

All Building Regulations for the UK and the Republic of Ireland make requirements for the prevention of harmful effects caused by condensation in roofs.

The relevant documents are:

England and Wales: Approved Document C2 2004 amd 2010 & 2013 'Resistance to moisture'. (Approved Document F2 which previously covered roof ventilation has been withdrawn.)

Scotland: Technical Handbook 2013 Domestic Buildings Section 3.15.3 'Control of condensation in roofs'.

Northern Ireland: Technical Booklet C 2012 'Site preparation and resistance to moisture'. Regulation C4 Section 7 'Roofs'.

Republic of Ireland: Technical Guidance Document F 'Ventilation' 2009. Section 2 'Condensation in roofs'.

WARM ROOFS

WITH SMALL OR NO VOIDS ABOVE SLOPING INSULATION

Meeting the requirements

All the regulations and supporting documents throughout the UK and Ireland now cite BS 5250: 2011 ‘Code of practice for control of condensation in buildings’ as the main means of compliance.

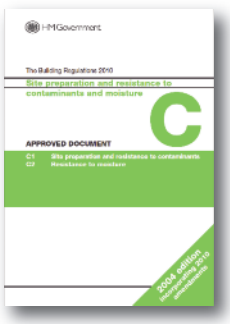
Section H.4 refers to roofs and is subdivided into cold roofs with large voids above horizontal insulation and warm roofs with small or no voids above sloping insulation.

The harmful effects of condensation can be controlled by the ventilation provisions shown here.

Notes to drawings:

Figures are given in 000s of mm^2 per metre, eg 5 = 5000mm^2/m

Impermeable underlays (type HR)
Vapour permeable underlays (type LR)
Air and vapour control layer



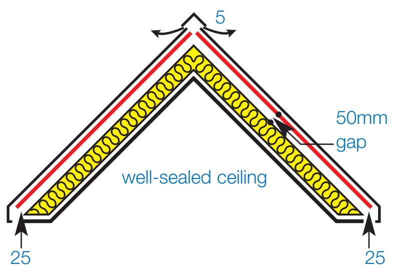
Impermeable underlays (type HR)

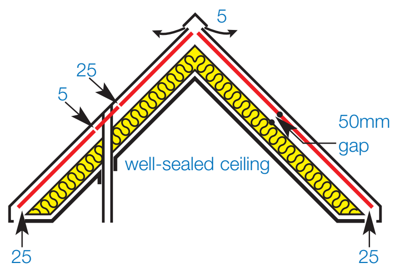
All roof types

All roof pitches:
Ventilation beneath the underlay and above the insulation of 25 000mm^2/m at eaves or low level and 5000mm^2/m at ridge or high level.

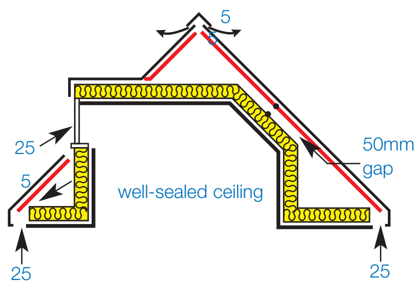
A ‘well-sealed ceiling’ must be provided as defined by BS 5250 clause H.3.2, and a separate air and vapour control layer on the warm side of the insulation. The space between the underlay and insulation should be at least 50mm deep with a minimum of 25mm at the centre of underlay drape.

Obstructions such as dormers, valleys, roof windows, compartment walls, fire barriers and changes in pitch create separate voids below the roof slope. Provide ventilation openings to each void at high and low level as shown in the examples.





Ventilation at compartment walls or fire barriers

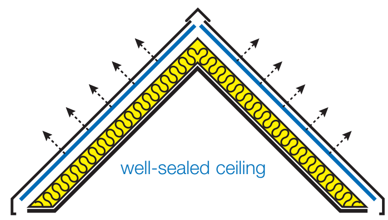


Room in the roof construction

Vapour permeable underlays (type LR)

All roof types with an air and vapour control layer

All roof pitches:
No ventilation is required provided that there is -
A vapour permeable underlay, either fully supported on insulation or draped unsupported, a well-sealed ceiling, and a separate continuous and effectively sealed air and vapour control layer on the warm side of the insulation.
If there is any doubt about the ability to provide and maintain the air and vapour control layer, provide ventilation as if the underlay were impermeable (as above).



No ventilation required subject to conditions

COLD ROOFS

WITH LARGE VOIDS ABOVE HORIZONTAL INSULATION

Impermeable underlays (type HR)

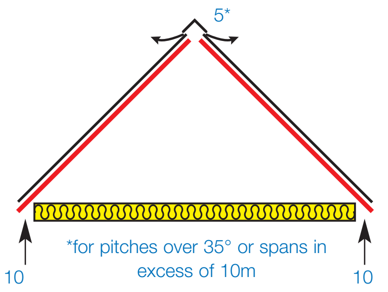
All roof types

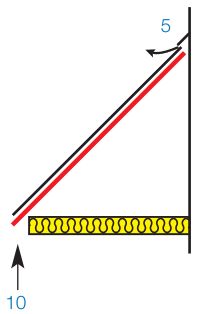
Roof pitch more than 15°
Ventilation beneath the underlay (or beneath timber sarking boards or sheets in Scottish practice) of 10 000mm²/m at eaves or low level.

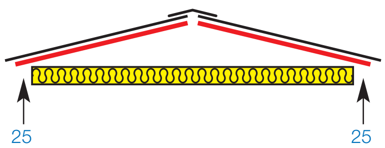
Roof pitch above 35°, or monopitch or lean-to roofs, or where roof span exceeds 10m:
Additional ventilation of 5000mm²/m at ridge or high level.

Roof pitch 15° or less:
Ventilation beneath the underlay (or beneath timber sarking boards or sheets in Scottish practice) of 25 000 mm²/m at eaves or low level.

Flat roofs: ventilation of 25 000 mm²/m at two opposite roof edges.







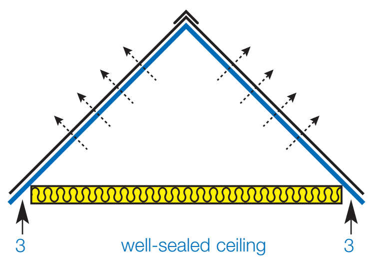
Vapour permeable underlays (type LR)

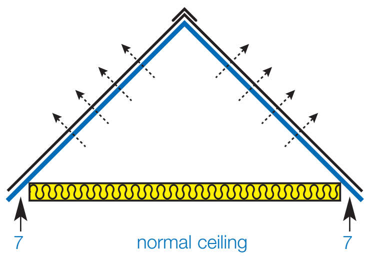
Dwelling-sized roofs

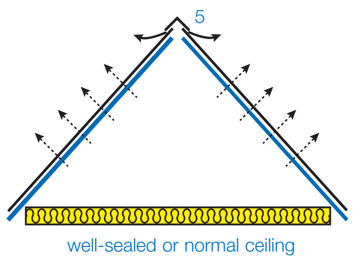
All roof pitches, with 'well-sealed ceiling' as defined by BS 5250 clause H.3.2:
Ventilation beneath a vapour permeable underlay (or beneath sarking boards such as 150mm planks in Scottish practice) of 3000mm²/m at eaves or low level.
This reduction is possible due to the vapour permeability of the underlay.

All roof pitches, with ceiling not well-sealed (likely in re-roof situations):
Ventilation of 7000mm²/m at eaves or low level.

Alternative solution (all ceilings):
Ventilation of 5000mm²/m at ridge or high level only.





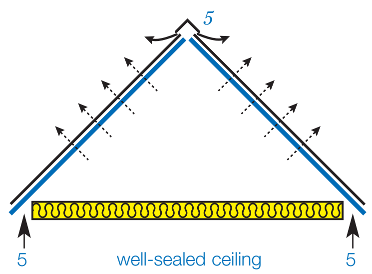


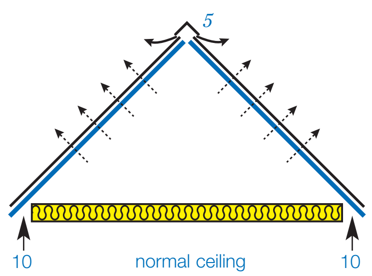
Vapour permeable underlays (type LR)

Larger than dwelling-sized roofs

All roof pitches, with 'well-sealed ceiling' as defined by BS 5250 clause H.3.2:
Ventilation beneath a vapour permeable underlay (or beneath sarking boards such as 150mm planks in Scottish practice) of 5000mm²/m at eaves or low level plus ventilation of 5000mm²/m at ridge or high level.

All roof pitches, with ceiling not well-sealed (likely in re-roof situations):
Ventilation of 10 000mm²/m at eaves or low level plus ventilation of 5000mm²/m at ridge or high level.



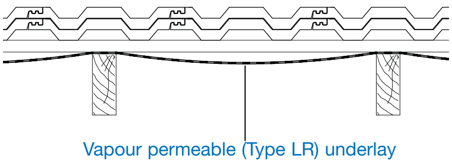


OTHER CONSIDERATIONS

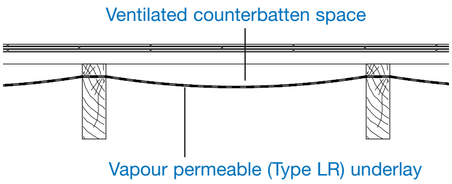
Roof coverings and batten space ventilation using vapour permeable underlays (type LR)

Where vapour permeable underlays (type LR) are used in both cold and warm roofs to contribute to the control of condensation, they do so by allowing water vapour to escape through the material by diffusion. It is important that this water vapour can escape through the roof covering to atmosphere from the tiling batten space. BS 5250 defines the level of air openness required of the roof covering and the test method. Traditional concrete and clay tiles should be sufficiently air open, but advice should be sought from the roof covering manufacturer/supplier.

Roof covering sufficiently air-open



Roof covering insufficiently air-open



For roof coverings that do not meet the required air openness, provide a counterbatten space at least 25mm deep, with ventilation of 25 000mm^2/m at eaves or low level and 5000mm^2/m at ridge or high level. This is in addition to the ventilation already specified for cold and warm roofs.
With impermeable underlays (type HR) this ventilation is unnecessary as there will be relatively little moisture transfer from within the building to the batten space.

Other recommendations

To achieve good air circulation within any ventilated large void in a roof, openings should be placed on the longer sides of a roof; if this is not possible, provide equivalent openings on the shorter sides that will allow good through ventilation, avoiding stagnant air pockets.

The entry of rain, snow, birds and large insects should be prevented. The latter can be achieved by a nominal 4mm mesh/grille, which will also avoid excessive airflow resistance.

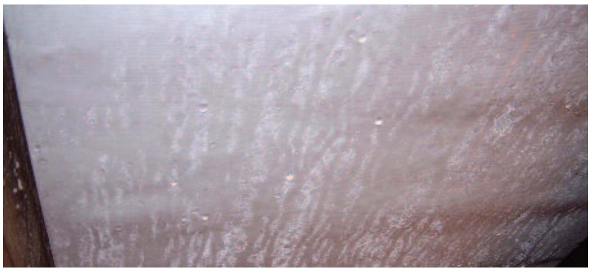
Ventilation openings should provide a continuous weatherproof path between the roof space and the outside air without compromising the weatherproof function of the underlay or the roof covering.

Both vapour permeable (type LR) and impermeable (type HR) underlays with a smooth underside can cause problems from condensate run-off. Underlays which can hold or absorb moisture on their underside and re-evaporate it when conditions are more favourable are preferable.

Sealed ceilings

Sealing the ceiling of any building will reduce both moisture transfer and heat loss, thus minimising the risk of condensation in the roof. However, a totally airtight ceiling is extremely difficult to achieve in practice. A 'well-sealed ceiling' is more possible but requires high standards of workmanship by the trades involved installing plasterboard or other ceilings, plumbing and electrical services. It is important to consider at design stage how construction details can be achieved that are robust over the lifetime of the building.

When existing buildings are being refurbished or re-roofed, the advantages of improving the existing ceiling should be considered. It may, however, not be possible to achieve a well-sealed ceiling and that should be borne in mind when determining the form of construction and ventilation provision.



Vapour permeable underlay (type LR) with smooth underside showing condensate run-off and dripping.

Impermeable underlay (type HR) with flocked underside showing condensate being held.

The consequences of inadequate roofspace ventilation