INFORM

CONDENSATION

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

Fig. 1: Surface condensation is most often seen on windows; this can be a problem on both double and single glazed windows (Copyright MERU).

CONDENSATION

Condensation is the process which sees water change from a gas or vapour to a liquid. This process happens due to a reduction in the temperature of water vapour which causes it to condense and form liquid moisture. It occurs in many situations, both naturally and in chemical engineering. This INFORM guide considers one specific type of condensation and provides a very basic introduction to the subject of condensation in traditional buildings. Understanding this dynamic is crucial in ensuring buildings are kept in good condition, especially with the increased condensation risks associated with improving the thermal performance of building fabric (i.e. through insulation and/or making them more air-tight).

Why condensation occurs

Within a building there are many processes which see moisture vapour entering the air. Breathing, drying clothes, cooking and bathing, all add moisture to the internal environment of a building. When air is warm, it can hold this moisture as a vapour. However, if the temperature of the air is reduced or the moisture laden air comes into contact with a colder surface then the moisture molecules become less mobile and turn to liquid. This is the process by which water condenses within a building.

Types of condensation

There are two principal types of condensation which can occur within a building: surface condensation and interstitial condensation. Surface condensation is the more obvious of the two and occurs when warm moist air comes into contact with a cold surface. This is most commonly seen where condensation forms on the surface of windows (Fig. 1). However, moisture will condense on any cold surface within a building; for example, where a masonry wall is thinner at the point where a press (cupboard) is built into the wall, or on the underside of a slate roof if the ability of the roof to disperse moisture has been reduced through the use of materials which restrict the evaporation (such as bituminous roofing felt).

Interstitial condensation forms within building fabric. This occurs when moisture enters building fabric and then reaches a point at which it is too cold to exist as vapour and condenses into a liquid. The point at which this occurs is often referred to as the dew point. Interstitial condensation can occur within almost any building fabric, including insulation that has been retrofitted to a building. The process of interstitial condensation forming within building fabric is an accepted part of traditional construction and, where a wall has sufficient ability to allow moisture to evaporate back to vapour and

Fig. 2: Surface condensation can lead to decay of adjacent building elements; here, the condensation on the window is causing mould and decay to its timber surround (Copyright Glaze and Save).

Fig. 3: The moisture created by condensation can lead to mould growth on building fabric (Copyright MERU).

dissipate or where water can disperse through capillary action, this will not cause a problem. However, where this process is restricted (for example, by the use of insulation which is impermeable to moisture or external cement render), moisture levels within the wall can rise over time and cause long term damage to the building.

Why condensation is a problem

Moisture condensing and evaporating is an integral part of how traditional buildings work and, if the building is functioning as it should, this will not cause problems. However, where excess condensation forms either on the surface of or within the building fabric and is prevented from evaporating, considerable damage can occur in the long term. Condensation can lead to the moisture level of timber increasing to the point where rot and infestation can cause decay (Fig. 2). Masonry can also suffer deterioration as it becomes saturated with liquid water through the action of both surface and interstitial condensation, leading to salt mobilisation, frost damage and surface decay. Surface condensation can also lead to mould growth, which poses a threat to human health as well as building fabric (Fig. 3). Reducing the risk of condensation forming in a building is, therefore, important for the health of the building and its occupants.

Dealing with condensation

Where surface condensation can be seen on a window or a wall, it is a symptom of excess moisture within the internal environment of a building, and not a fault with the window itself, for example. The two fundamental methods of reducing problems of condensation are heating and ventilating. Raising internal temperatures will help reduce the likelihood of condensation, assuming ventilation levels are sufficient to eventually allow moisture to leave the building and the building fabric is sufficiently vapour open to allow moisture to dissipate. However, this may not always be possible due to cost, especially where fuel poverty is an issue.

The most effective method of dealing

with condensation within a building, therefore, is to reduce the internal moisture load. For example, drying clothes outdoors reduces the amount of moisture internally; if drying clothes inside, this should be done in a well-ventilated part of the building. Likewise, when having a bath or shower, opening the windows will allow any moisture to dissipate. Mechanical extract ventilation in both kitchens and bathrooms should be run during and after cooking and bathing.

Ventilation is important in reducing the effects of condensation; if warm moist air can disperse from within a building, it will not have a chance to form condensation. As such, if, after considering the internal moisture load, problems with condensation persist, looking at the building's ventilation levels should be the next step. This can involve checking sub-floor vents (which ventilate under floor boards and up behind lath-and-plaster wall-linings) are clear; that warm moist air can leave the building through the roof space; and that mechanical extract ventilation in bathrooms and kitchens is operating effectively (Fig. 4). Humidity controlled mechanical extract fans may be considered, as these switch on and off at pre-determined humidity levels and can be more effective and efficient at controlling humidity than manually controlled units. Disused chimneys should be vented both within a room and at the top of the chimney stack.

A further step to reducing the potential impact of condensation is to ensure that all parts of the structure allow moisture to disperse when conditions allow. This means that any materials used in repair or thermal upgrade of traditional buildings should allow moisture to move freely. For example, insulation should be permeable to moisture and any external renders and pointing should be based on lime (which allows moisture to pass through its structure), rather than impervious cement. Maintaining a vapour-open structure will help reduce condensation risk.

Fig. 4: Inadequate extract ventilation can be ineffective at removing condensation from buildings.

Condensation following thermal upgrade

Despite insulation often being prescribed as a solution to problems of condensation, as traditionally constructed buildings are made more thermally efficient, the risk of condensation can increase. Making a building more airtight, which will often occur when it is made more thermally efficient, can reduce ventilation to a level where moisture cannot dissipate from within a building. Where a mass masonry wall is insulated internally, this makes the masonry behind the insulation colder, raising the risk of condensation. In addition, when one part of building fabric is insulated, it will often have the effect of making

Fig. 5: Where lofts are insulated this reduces the temperature of sarking boards therefore raising the risk of condensation forming on the colder surface. This can lead to mould growth as seen in this image.

another part colder. For example, if a loft is insulated, the roof space above drops in temperature (Fig. 5). It is, therefore, important to ensure that any thermal upgrade of a building is considered holistically. For example, if loft insulation is being installed, consider adding additional ventilation. Ventilation of the roof space above is also important. Prior to any thermal improvement, the presence of any layers which are likely to inhibit the dispersal of moisture, such as external cement render or bituminous felt on sarking boards, should be ascertained as this will exacerbate the likelihood of condensation forming.

Condensation risk assessments

In some situations, especially where a building is being thermally upgraded, condensation risk assessments are undertaken. The procedure for carrying this out should be carefully considered, however. The majority of proprietary software for carrying out condensation risk assessments is based on what is termed the "Glazer Method" (as cited in the British Standard BS EN ISO 13788:2012), but this has significant restrictions in how it treats traditional buildings. Therefore, the results of any procedure which uses this method should be treated with caution. A greater level of success when dealing with condensation in traditional construction can be obtained through the use of hygrothermal simulation (see Further Reading: *Technical Paper 15).*

Condensation and Building Standards

In Scotland, Building Standard 3.15.1 - titled "condensation" - requires that new or converted buildings are designed and constructed in such a way that there will not be a threat to the building or the health of the occupants as a result of moisture caused by surface or interstitial condensation. This is often interpreted as implying that traditionally constructed buildings must incorporate vapour barriers and materials which are impermeable to moisture, in order to reduce the risk of condensation. This is not the case, however, as the intent of the standard is to prevent potential damage to a new or converted building or the health of the occupants from the effects of surface or interstitial

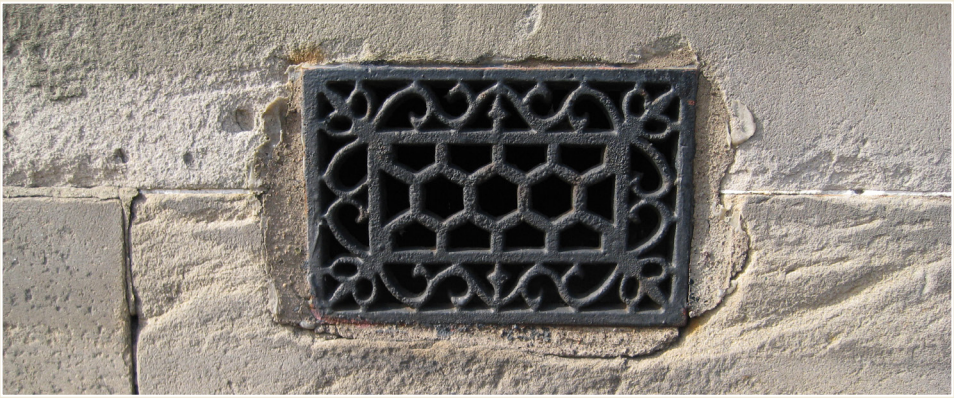

Fig. 6: External ground level vent: maintaining ventilation is one of the most effective means of reducing condensation risks in traditional buildings.

condensation, rather than precluding either from occurring. Standard 3.15 does not, therefore, require the use of a particular method to eliminate the risk of condensation causing damage or health risk.

Where British Standard BS 5250:2002 is referenced as an aid to design, it should be noted that this standard contains a clause which excludes breathing walls and those of traditional construction, for which specific advice should be sought. The requirements of the standard relating to condensation can be met through ventilation, the use of hygroscopic materials to buffer humidity and the maintenance of the material properties of traditional building fabric which is permeable to moisture and promotes its dissipation (Fig. 6).

Conclusion

Condensation and evaporation of water vapour is always present within buildings, primarily as a consequence of human occupation. Buildings of traditional construction which are vapour open deal with condensation differently to those constructed of modern, vapour-closed materials. If the correct balance between ventilation, heating and traditional buildings is not achieved, condensation can lead to increasing levels of moisture in the fabric of the building. This, in turn, can lead to decay and deterioration of the building fabric and unhealthy living conditions for the occupants. Condensation, particularly more visible surface condensation, is generally a sign that one of these factors is not being achieved.

Further reading

Technical Paper 15: Assessing Risks in Insulation Retrofits using Hygrothermal Software Tools, J. Little, C. Ferraro & B. Arregi, Historic Scotland (2015).

Short Guide 1: Fabric Improvements for Energy Efficiency in Traditional Buildings, Historic Scotland (2013).

British Standard BS 5250:2002: Code of practice for control of condensation in buildings, British Standards Institution (2002).

Further information

HES Technical advice
T: 0131 668 8951
E: technicalresearch@hes.scot

HES Casework and designations
T: 0131 668 8716
E: hmenquiries@hes.scot

HES Grants
T: 0131 668 8801
E: grants@hes.scot

Sustainable Traditional Building Alliance (STBA)
T: 020 7704 3501
E: info@stbauk.org
W: www.stbauk.org

Society for the Protection of Ancient Buildings (SPAB)
T: 020 7377 1644
E: info@spab.org.uk
W: www.spab.org.uk

THE ENGINE SHED
AN SEADA EINNSEIN
SCOTLAND'S BUILDING CONSERVATION CENTRE

THE ENGINE SHED

The Engine Shed is Scotland's buildings conservation centre. Run by Historic Environment Scotland, it is a hub for everyone to engage with their built heritage. We offer training and education in traditional buildings, materials and skills. For more information, please see our website at www.historicenvironment.scot or email technicaleducation@hes.scot.

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

Historic Environment Scotland
Scottish Charity No. SC045925

Principal author: Dr Moses Jenkins
First published: August 2020
Credit cover image: Glaze and Save
Historic Environment Scotland, Longmore House
Salisbury Place, Edinburgh EH9 1SH Tel: 0131 668 8600