CONSERVATION & RESTORATION

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Principles of treatment

Condensation, cold bridging and mould

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Introduction

In recent years the incidence of condensation and mould in buildings has risen from a level of comparative insignificance to become a major domestic problem. The increase can be attributed to changes in design of living accommodation and in the lifestyle of the occupants. A major factor in the last few years has been escalating fuel costs and a growing awareness of the need to conserve energy resulting in more widespread use of double glazing, better draught exclusion and in many cases increased us of paraffin and bottled gas heaters.

What is condensation & cold bridging?

Condensation as the name suggests is water which has 'condensed' from warm, moist air on contact with a cold surface. Air holds water in the form of water vapour (moisture). Warm air is able to hold more moisture than cold air. Air which contains its maximum moisture content is said to be saturated. Roughly speaking the amount doubles for every 10°c rise in temperature.

Air temperature	Max Moisture Content
0°c	o.38%
10°c	0.77%
20°c	1.47%
30°c	2.68%

The amount of moisture in the air is usually expressed as Relative Humidity (RH). Saturated air is said to have 100% RH. The RH of air with a particular moisture content will vary with temperature, so as the air is cooled its relative humidity will increase

	Air Temperature	Relative Humidity
	20°c	50%
0.74% Moisture Content	15°c	68%
	10°c	95%
	9°c	100%

Below 9°c the air in the above example would be incapable of holding any more moisture and the surplus would be released as condensation. The temperature at which this occurs is known as the Dew Point and is dependent upon the amount of moisture in the air. The higher the moisture content, the higher the Dew Point.

Cold bridging is caused by a colder element in the structure or fabric of the building allowing coldness to pass through EG the external wall. When warm moist air is present in the property and it passes through the colder elements of the structure we have cold bridging.

This is often caused by a combination of issues. It can occur from things such as having a shower or a bath, cooking or clothes washing, particularly if you are drying washing on the radiators.

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When does condensation occur?

Condensation is chiefly a winter problem. The external air temperature is low and external walls and windows are cold. The usual sequence of events is as follows:

1. Cold air enters the building
2. The air is warmed for the comfort of the occupants
3. The warm air takes up moisture
4. The warm, moist air comes into contact with cold surfaces, walls, windows etc. And is cooled below its Dew Point
5. Condensation occurs as the excess moisture is released

Walls in kitchens and bathrooms (where moisture levels are usually highest), solid external walls, cold bridges such as concrete lintels set in cavity walls are commonly the areas in which condensation takes place.

Intermittent heating and cooling of the property can aggravate condensation problems, since it allows external walls to remain cold and act as condensation points for damp air.

Sources of moisture

The main sources of moisture in domestic properties are:

- Paraffin and unventilated gas heaters
- Cooling
- Clothes washing and drying
- Baths, dish washing etc.
- Occupants

Excluding heating, it is estimated that a family of 4 with associated cooking, laundering, etc, will generate almost 14 litres of water a day. In addition, a free standing gas of paraffin heater could contribute a further 5 litres of water vapour. (4.5 litres of paraffin will generate 5 litres of water when it burns). This water, in the form of water vapour, must be absorbed by the air in the house or deposited out as condensation if corrective action is not taken.

Problems caused by condensation

Running water on windows and walls is perhaps the most immediate indication of a condensation problem. If ignored, this can lead to a deterioration in the decorative condition of the property, stained curtains and decay in window frames.

The appearance of moulds on the surface of wallpapers and paints in poorly ventilated areas; e.g. behind large pieces of furniture, in cupboards and in corners of rooms is not uncommon and in severe cases may occur on furnishing, books, papers and even clothing in wardrobes.

Condensation can occur under suspended floors greatly increasing the chances of dry rot outbreak.
A much less common form of condensation occurs when the Dew Point is reached, not on the surface of a wall but within the structure itself. This is known as interstitial condensation and can easily be mistaken for rising damp.

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Overcoming condensation & cold bridging

To alleviate cold bridging, where condensation and mould is involved, striking a balance of warm and coolness of the air, ventilation and movement can reduce considerably the chances of condensation. Airing the room by opening the windows is extremely affective and is often over looked

It has been shown that condensation results from moist air coming into contact with cold surfaces and that the likelihood of condensation increases with the amount of moisture in the air. Mould development within a building is unlikely to occur if the Relative Humidity is maintained below 70%

Heating the air alone is unlikely to be a satisfactory solution, not only on grounds of cost, but also practicality. Unless cold surfaces are eliminated, condensation at some point is inevitable. Any remedial action, therefore, must involve both lowering of moisture levels and the elimination of cold surfaces.

Improved heating and ventilation coupled with specific action in relation to cold spots will usually result in a significant improvement in conditions, although there may be circumstances in which alternative methods are required. A low but constant background heat is preferable to intermittent heating, since this will help to maintain a higher ambient temperature in the fabric of the building.

The installation of a small extractor fan in a kitchen or bathroom will carry away moisture-laden air from two areas most responsible for condensation with minimal running costs. This is now required by the Building Regulations in new construction. Extractor fans are now available which incorporate a humidistat which will control the operation of the fan within certain humidity limits.

When an open fire or fixed gas fire exists, a certain amount of 'natural' ventilation will occur and where additional ventilation is provided it is important that this is not blocked off.

Particularly cold walls can be insulated by covering with a foam lining paper or polystyrene tiles, however, the provision of a vapour barrier on the warm side of the insulation may be found necessary to prevent condensation occurring behind the insulation.

Exposed walls will often benefit from an external spray treatment with a masonry water repellent, since this will reduce loss of heat from evaporation of absorbed water. This form of treatment on solid walls and cavity wall insulation in cavity walls will help to overcome interstitial condensation.

Sub-floor condensation is best dealt with by ensuring good sub-floor ventilation, installing extra air bricks if necessary. Where the ground is particularly damp, further reduction of moisture levels can be achieved by spreading a polythene sheet, or other impervious membrane, e.g. bitumen, on the soil oversite.

An alternative to heating and ventilation for the control of moisture in the air is a dehumidifier. This is a device which draws in air, cools it to remove moisture which is collected in a reservoir and reheats it to an acceptable temperature before recirculating it. The running costs of the equipment will depend on its size and the amount of moisture in the atmosphere.

In dry air, moisture on the skin will evaporate more readily than in moist air. A reduction of the moisture level in a room, therefore, will appear to be accompanied by a reduction in temperature. This is purely subjective and will happen whether moisture is removed by natural ventilation or by artificial means.

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Diagnosis of condensation

Condensation on walls will frequently start at lower levels where the air is coldest and spread out from corners where air flow is minimal. In such circumstances the dampness pattern can often be confused with rising damp. Careful observation and measurement will however, usually make distinction between the two very clear.

Observation

- Presence of running water on cold surfaces
- Presence of gas or paraffin heaters, wet washing, etc.
- Moulds, usually but not exclusively black on surface of paint or wallpaper, particularly in corners and behind large items of furniture
- Absence of hygroscopic salts

Measurement:

Uniformly high moisture readings on wall surface (as distinct from a descending moisture gradient in the case of rising damp).
Wall temperature below Dew Point
High surface moisture level, lower subsurface moisture level (not always positive indication)

Measurement of relative humidity and determination of dew point

The concepts of Relative Humidity and Dew Point have been described. It is a comparatively simple matter with the aid of surface thermometer and hygrometer to measure wall temperature and Relative Humidity within a room and, by reference to charts, determine the Dew Point.

Digital thermometers with air and surface probes are now available, as are digital hygrometers which give direct readings of Relative Humidity.

Certain electrical moisture meters used within the industry are equipped with adequate surface thermometers and Relative Humidity can be determined with the use of a wet and dry bulb hygrometer (whirling type).

Having Determined the Relative Humidity, and noted the air temperature in the room the Dew Point can be found by reference to a chart, (see below)

If the surface temperature is at or below Dew Point, condensation is possible.

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Possible Solutions:

A. Mould remedial action necessary based on building use

1. Maintain reasonable background heat levels in the property. If a room is allowed to cool the door into it should remain closed to prevent warm damp air entering from the remainder of the dwelling, and condensing in the room.
2. Limit the drying of clothes internally and if clothes are dried inside they should be dried in well-ventilated rooms (with windows open) and with the doors closed to other parts of the dwelling.
3. Limit the use of movable gas heaters, as this type of appliance releases large amounts of water vapor into the air, if they are used an external window should be left ajar in the room to allow fresh air to enter and the moisture produced to escape quickly.
4. After using the bath the windows should be kept open/ or extract fan on and the door closed until all the moist air is removed.

B. Mould remedial action based on building defects

1. Remove mould from all surfaces where present by washing the surface with a suitable fungicidal solution and allow it to drying. A dehumidifier can be used to aid the drying. Do not attempt to brush the mould off the walls, as this will just spread it.
2. Increase ventilation to rooms.
3. Engage a specialist to inspect roofs, walls, balconies etc for leaks in water proofing membrane and flashings. Perhaps a DPC (damp proof course) or DPM (damp proof membrane) is missing or damaged. Bear in mind that water entering a leak can penetrate in one place, track along a surface and exit in a remote spot.
4. Provide additional insulation to avoid cold spots on walls, floors and ceilings.
5. Provide a mechanical extract fan to 'wet' rooms i.e. bathroom.
6. Finally, the building should be regularly maintained by:

    - Checking, maintaining and clearing gutters, drains, gullies and downpipes.
    - Removing weed and plant growth from the building facades.
    - Carrying out regular inspections and repairing any damage to downpipes, roofs and gutters promptly.

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Further information

This short information leaflet can only serve as an introduction to what is a complex problem.

The following publications are recommended for further reading on the subject:-
BRE Digest 297: Surface condensation and mould growth in traditionally built dwellings
BRE Digest 369: Interstitial condensation and fabric degradation
BS 5250 (1989): Code of basic data for the design of Buildings: The control of condensation in dwellings

DEW POINT TABLE

	RELATIVE HUMIDITY													
Air Temp °C	20	25	30	35	40	45	50	55	60	65	70	75	80	85
1														0
2														0
3													0	1
4												0	0	1
5											0	0	1	2
6										0	1	2	3	4
7									0	1	2	3	4	5
8								0	1	2	3	4	5	6
9							0	1	2	3	4	5	6	7
10							0	1	2	4	5	6	7	8
11						0	1	2	3	5	6	7	8	9
12						0	2	3	4	6	7	8	9	9
13					0	1	3	4	5	7	8	9	10	10
14				0	1	2	4	5	6	7	9	9	11	12
15				0	2	3	4	6	7	8	10	11	12	12
16				0	2	4	6	7	8	9	11	12	13	13
17				2	3	5	6	8	9	10	11	12	13	14
18			0	2	4	6	7	9	10	11	12	13	15	15
19			1	3	5	7	8	10	11	12	13	14	15	16
20		0	2	4	6	8	9	11	12	13	14	15	16	17
21		0	3	5	7	8	10	12	13	14	15	16	17	18
22		1	4	6	8	9	11	13	14	15	16	17	18	19
23	0	2	4	7	9	11	12	13	15	16	17	18	19	20
24	0	3	5	8	10	11	13	14	16	17	18	19	20	21
25	0	4	6	8	10	12	14	15	17	18	19	20	21	22
26	1	5	6	9	11	13	15	16	18	19	20	21	22	23
27	2	5	8	10	12	14	16	17	19	20	21	22	23	24
28	3	6	9	11	13	15	17	18	20	21	22	23	24	25
29	4	7	10	12	14	16	18	19	20	22	23	24	25	26
30	5	8	11	13	15	17	19	20	21	23	24	25	26	27

Note: Blank squares indicate dew points below 0^0C

The information contained in this leaflet is given in good faith and believe to be correct. However it must be stressed that of necessity it is of a general nature.