AIC 15e

2.:

CONDENSATION CONTROL

Interstitial condensation | Importance of ventilation openings
Vapour control layers | Timber and concrete flat roofs
Cold and warm deck roofs | Moisture levels

HIGH AND DRY

Ken Johnson looks at condensation problems associated with different types of roofs.

Principles of condensation control in roofing are fairly simple, but difficulties arise because of the variety of types, sizes and shapes of roof encountered in practice. Failure to understand the principles appropriate to a particular roof makes it all too easy to introduce condensation problems, often serious ones.

The term surface condensation should be reserved to describe condensation on visible surfaces within the building – this phenomenon is controlled only by the temperature of the surface and the moisture content of the air.

On the other hand, the term interstitial condensation should be used to describe condensation (usually on surfaces) within or between the layers of the building envelope: here the risk is still determined by the temperature of the layers and the amount of moisture present, but the amount of moisture itself is controlled by the vapour resistances of the various layers, or by sizes of physical holes, which determine the rate of arrival and rate of dispersal from any point.

The significance of this is that the moisture at any point can be reduced by having a high vapour resistance layer: for example, a vapour control layer (VCL) near the inside of the construction and either low vapour-resistance layers at the outside or by dispersing moisture from within the construction by ventilation.

Condensation occuring in a flat or pitched roof is thus of interstitial type, even though it is often on surfaces, and the vapour resistances, holes and ventilation of air spaces are all of paramount importance in understanding risk control.

Before attempting work on any roof, be it repair, maintenance or upgrading, it is necessary to determine how the roof is designed to work, and to make sure that if the principles are correct, they continue to be complied with.

Alternatively, if the principles are found to be wrong, or if there is to be some alteration to the structure or change of use of the building, then the whole design should be checked and if necessary corrected. No condensation problems before work starts is not a guarantee of no problems afterwards, unless this is heeded.

The need is to understand the various types of roof and their associated design principles for the control of condensation. Roofs fall into one of two broad categories which are commonly termed cold and warm deck when referring to flat roofs; however, these terms are equally applicable to pitched roofs, and so the design principles are split here under these headings.

Basically, the difference is caused by the position of the insulation, relative to the deck. It will be seen therefore that conventional domestic pitched roofs with ceiling level insulation are cold deck roofs, and conventional concrete roofs topped by insulation and covered, for instance, with felt and bitumen, are warm deck roofs.

Terminology

In the following discussion a difference is intended between the terms VCL and vapour barrier. The latter is meant to indicate an absolute barrier to moisture, such as roofing felt laid in hot bitumen with sealed laps. A VCL is anything less than this, usually a polythene sheet, or even just a polythene or foil backing to plasterboard, where some resistance to moisture transfer is provided.

In cold deck roofs, since the deck will be cold and there will be imperfections in the VCL, or holes around service pipes, moisture will penetrate to the deck. Calculation will show a high risk of condensation on this surface.

Using the principles of interstitial condensation control, risk can be reduced by one of three approaches:

- ☐ install a perfect vapour barrier below the insulation
- ☐ ventilate the area between insulation and deck
- ☐ use a very low vapour-resistance outer deck.

In practice the first approach is difficult to achieve; the second is the usual method; and the third is usually impossible because the deck elements also form the weather barrier.

In warm deck roofs, the insulation will maintain the deck in a warm condition, with little risk of condensation. However, the outer weather barrier now becomes the problem layer since it necessarily has high vapour resistance and it is kept cold by the insulation. Vapour must not be allowed to reach this layer, and a perfect vapour barrier on the warm side of the insulation must be achieved and maintained.

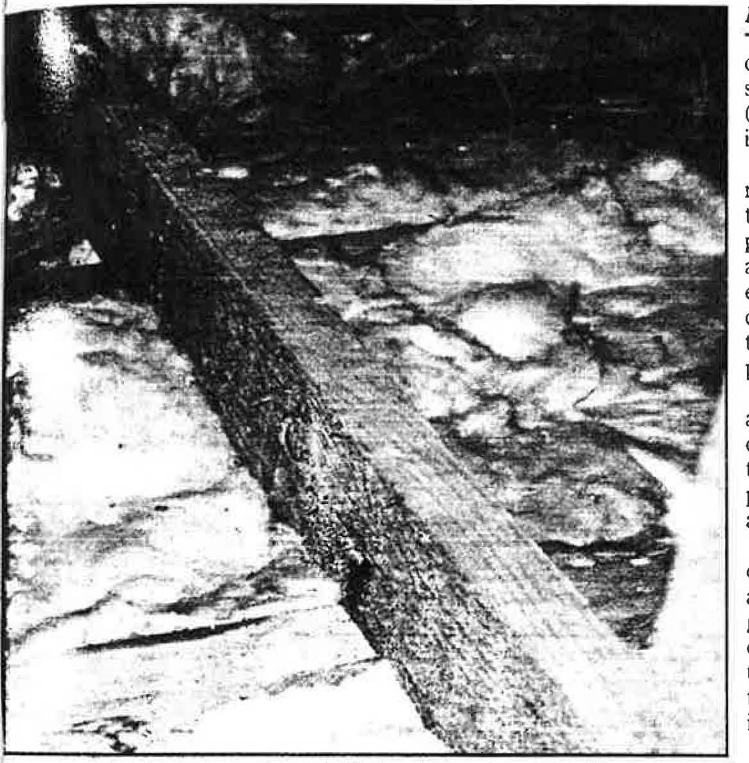
It is also essential that during alterations moisture is not trapped between the vapour barrier and the outer weather barrier, for there is no way that it can dry out.

There is another version of the warm deck roof in which the deck also forms the weather barrier: the insulation above the deck is allowed to get wet and must be one suitable for this application – it must not degrade and should allow rain-water to drain away quickly. There is a loss of thermal performance, extra thickness is used to compensate for this. This is referred to as an inverted roo[f]

In pitched roofs, the insula[tion] can be laid horizontally at ceili[ng] level, forming a cold deck roo[f] or under the slope of the roof, still forming a cold deck if laid between or below the rafters a warm deck type if above the rafters on some form of deck.

In cold deck roofs, it is fairl[y] easy to ventilate the air space above the insulation, so little attention is usually paid to the moisture entering the construction. This approach creates unnecessary risk and easy to avoid; until the controversy is resolved abou[t] the relative amounts of moist[ure] entering the space by diffusio[n] through actual holes, it is bes[t to] reduce both.

Use foil or polythene-back[ed] plasterboard, seal around wa[ter] pipes and cables with a flexib[le] mastic, locate access hatches rooms other than bathrooms weight hatch covers and use compressible seals, and cove[r] water tanks (remember too t[hat] such covers will suffer from surface condensation on thei[r]



Run-off condensate on loft boarding.

underside – choose material that does not degrade and is so shaped that condensation runs back into the tank).

Maintain or create ventilation openings along both eaves of normal pitched roofs equivalent to a 10 mm continuous gap for pitches of more than 15°, and equivalent to 25 mm for less than 15°.

Lean-to roofs

For lean-to roofs, where only one length of eave is available, an opening equivalent to a 5 mm continuous gap is recommended at the top junction with the wall (however, this may prove far too small, and at least the size used at the eaves should be used). In addition in normal pitched roofs, if the pitch is more than 20° or if the span is more than 10 m, high-level ventilation is recommended equivalent to a continuous gap of 3 mm (this also may be rather small).

Particular attention should be paid to eaves detailing to ensure the necessary air gaps while maintaining insulation thickness and avoiding cold bridges: in most existing roofs this cannot be done and the insulation thickness must suffer.

Care should be taken when pitched roofs are split into compartments (for example, above flats) when each section should be treated as an individual roof; stagnant pockets of air must be avoided.

A cold deck construction with insulation laid under the slope of the roof makes ventilation of the air space more difficult as there is resistance to flow due to the size and shape of the gap. Restriction of moisture flow into the air space is therefore much more important, and the VCL becomes essential. It should preferably be 500 g polythene sheet with sealed joins and, if an opening is necessary, the polythene should be sealed to the pipe or whatever.

Clearly, eaves-to-eaves ventilation is impossible, so an opening equivalent to a 3 mm continuous gap is recommended at or near the ridge, increased to 5 mm if the pitch is greater than 20°, or the span is 10 m or more (again it might be better to have an opening the same as at the eaves). At the eaves, openings equivalent to a 25 mm continuous gap should be provided in all cases, and a 50 mm minimum air space left between the sarking (after allowing for sagging) and insulation.

In addition, since risk here is relatively high, timbers above the VCL should preferably be pressure impregnated; detailing at ridge and eaves is important, ensuring that the VCL is continuous and insulation thickness is maintained if possible.

When a room is situated within a pitched roof, all walls and ceilings of the room should be treated according to the principles described above as appropriate.

Flat roofs can be split into two categories – those built of timber and those using concrete. In general the cold deck condensation risks are higher than in the pitched roof cases as the ventilation paths are not inclined.

In timber cold deck construction, ventilation of the air gap is restricted due to the resistance because of shape and size. There is a need therefore for a VCL to restrict moisture entry into the construction as well as for particular attention to the ventilation. It is also advisable to pressure impregnate the timbers within the construction.

The VCL should be 500 g polythene with sealed laps, and service gaps should be avoided if possible, or sealed if necessary. Cross-ventilation is essential through each section, with a 50 mm air space maintained between deck and insulation, and openings at each end equivalent to a continuous gap of 25 mm. If the roof sections end against a wall, it is still essential to detail the join to leave this opening.

The normal warm deck type has the insulation between the outer weatherproof finish and the vapour barrier. It is obvious that the vapour barrier must be perfect, with no penetration for services.

There is a problem with cold deck concrete roofs: insulation is often fixed direct to the concrete, with at best a VCL, so there is a condensation risk on the concrete. Provided the structure was completely dry before the fixing of the insulation this often appears to work. However, if an uninsulated roof is to be upgraded, it would be better to form a warm deck roof, but this would be unsuitable if the building is poorly or infrequently heated.

Warm deck roofs

In a warm deck concrete roof, the insulation keeps the screed/concrete deck warm. As with other warm deck roofs (except inverted) the insulation is sandwiched between the vapour barrier and the outer weaterproof finish, and as such, no moisture must penetrate to this area so the vapour barrier must be perfect and free from any penetration for services.

Care must be taken during any repair that moisture in the concrete deck can dry out inwards, and for that reason, any internal lining must be vapour permeable otherwise it will hinder drying.

It is also important to replace or position insulation over all roof areas, leaving no cold spots which might otherwise initiate surface condensation on the ceilings.

One last point which is often forgotten regarding all roofs, is that the atmosphere in the building below is the prime supplier of moisture to the roof. If moisture levels are reduced in the building itself, risks in the roof are automatically reduced, whether of good or bad construction. However, if a change of bulding use results in higher moisture levels, then much more care will be needed in ensuring the correct principles for the roof are complied with ●

References

BS 5250: 1975, *Code of basic data for the design of buildings: the control of condensation in dwellings.*
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