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Performance criteria for condensation

Introduction

Considerable quantities of moisture can be added to the indoor air of a building by the occupants and their activities, such as cooking and washing indoors. When the moisture-laden air comes into contact with any surface inside the building that is cooler than the dew-point temperature of the air, condensation occurs on that surface. Such a surface may be a window pane, a metal window frame, a badly insulated external wall, roof or ceiling, or any other area where a thermal bridge occurs. Construction details that may increase the risk of condensation should therefore be avoided.

General

It has been shown that while moist air is healthier than excessively dry air, high relative humidity (the norm in small overcrowded low income dwellings) leads to condensation on cold surfaces. Condensation can cause discomfort, for instance wetness of bedding, through water dripping from the roof. This makes it difficult to maintain the body's normal temperature at night.

Condensation may also lead to degradation of the building structure.

Furthermore, condensation increases the risk of mould growth. Studies have shown that several allergies like rhinitis and asthma, respiratory infections and other symptoms can be attributed to the spores germinated by mould in buildings.

There are various factors contributing to condensation in low income dwellings (eg overcrowding as well as cooking and washing clothes indoors). Condensation can occur in dwellings in most regions of South Africa in winter due to circumstances such as these.

One of the most important factors, however, is that of climate. In order to combat condensation in low income dwellings (and the associated problems), the climatic zone where it is most likely to occur needs to be identified.

The Southern Coastal Condensation Problem Area

In the course of the autumn of 2000, Transfer of Energy, Momentum and Mass, International (Pty) Ltd undertook a study on behalf of the National Home Builders Registration Council. Physical on-site investigations were combined with computer simulations of the thermal performance of low income dwellings and it was found that severe condensation is mainly a problem in the coastal area of the southern Cape, which is bordered by the imaginary line shown in the figure below.

Southern Coastal Condensation Problem Area

The boundary runs from Malmesbury, close to the south-west Cape coast,. then curves northwards, including Ceres and Tulbagh, but excluding Worcester. The line then runs north of Swellendam and Riversdale and between George and Oudtshoorn. Following close to the Cape coast, it eventually curves north again to include Uitenhage, Kirkwood and Grahamstown, finally ending at Port Alfred.

The study showed that the so-called southern coastal condensation problem (SCCP) area can be fairly easily identified by combining the following environmental features:

- the boundary runs south of the major mountain ranges in the Southern Cape
- it includes the area of the country receiving winter and all-year-round rainfall
- it receives a high annual rainfall (ie between 250 mm and 500 mm per year).

The fact that the boundary of the area depends on a combination of the Southern Cape mountain ranges, the winter/all-year rainfall area and the area receiving a high annual rainfall explains why the SCCP boundary forms "humps" at both the west and eastern ends.

The assessment of the likelihood of condensation occurring is carried out only on houses in this area.

Assessing the condensation potential of buildings

Shack: a dwelling with walls and roof constructed of unlined steel sheet, with a concrete surface bed.

Standard brick house: a dwelling constructed of 230 mm thick clay brickwork, plastered internally, with a concrete floor and a steel sheeted roof that has a ceiling but no insulation. Orientation and fenestration is as described in the paragraph above.

A computer program is used to predict the theoretical performance of a dwelling with regard to condensation and compares this with the condensation that will occur in four standard houses with different wall types as well as in a 41 m^2 steel shack.

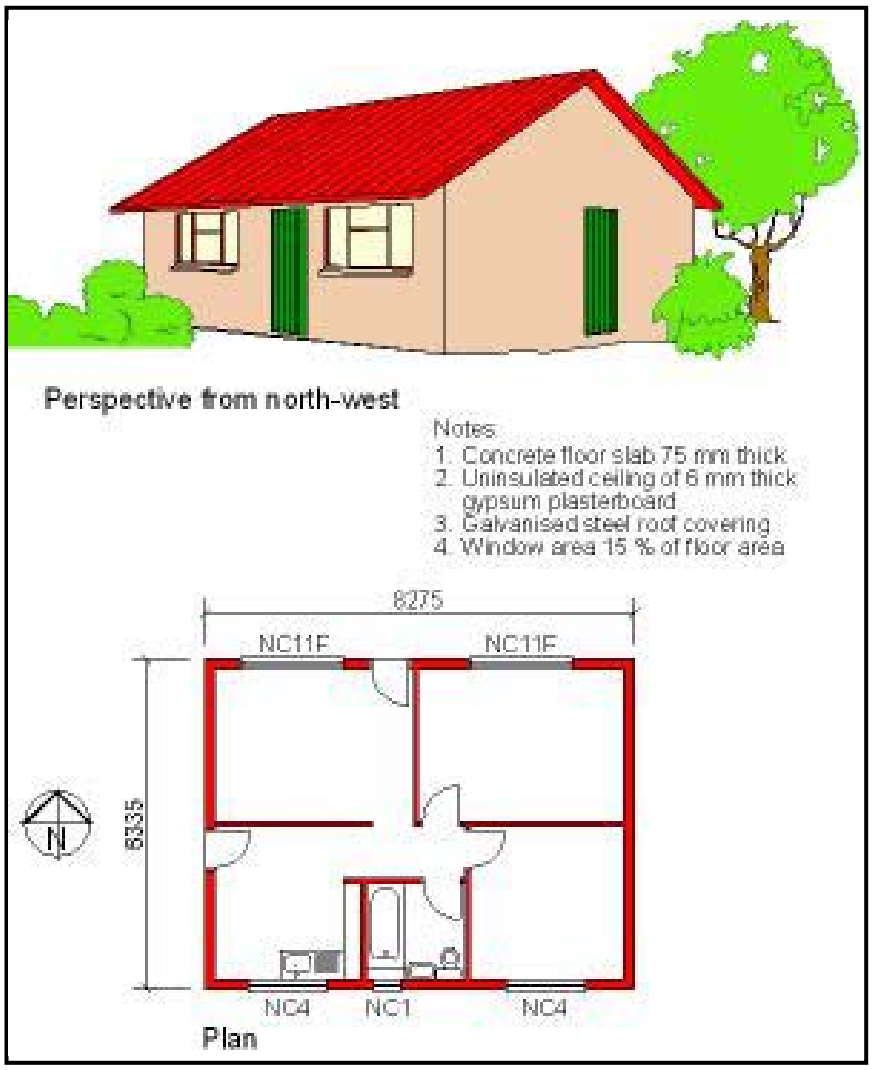
All the dwellings considered:

- are orientated true north (ie predominant windows of living areas face true north or the longer axis of the building runs as near east/west as possible)
- have an overall area of 53 m^2
- with the total window area not exceeding 15 % of the floor area
- have a corrugated steel roof.

The calculations are made for houses with:

- no ceilings
- 6,4 mm thick gypsum plasterboard ceilings
- ceilings with 40 mm thick glass-fibre or mineral wool insulation, installed above and in close contact with the ceiling.

Condensation acceptability and criteria



The standard brick house

The method of presenting the condensation performance levels is shown in tabular form in Agrément certificates. The table displays the wall temperature in relation to dew point temperature within the dwelling being evaluated and compares this with that of four dwellings of similar size, layout, fenestration and orientation that each utilises a common but different form of conventional construction for the external walls, namely:

- 270 mm thick burnt clay brick cavity walls, plastered internally
- 230 mm thick burnt clay solid brickwork, plastered internally (the standard brick house)
- 140 mm thick hollow concrete masonry units, plastered externally
- 140 mm thick solid concrete bricks, plastered externally.

Each of the conventionally constructed dwellings is assumed to have an uninsulated ceiling.

The wall temperatures are also compared with those of a 41 m^2 shack, which has a very poor thermal performance.

The values obtained for these five types of house construction are tabulated in Agrément certificates together with those obtained for the subject under evaluation. An example of such a table appears on page 5.

Agrément South Africa requires that the minimum level of performance with regard to condensation in dwellings that are to be erected in the SCCP area, is equivalent to that of the standard brick dwelling, **which is itself not immune to condensation problems**.

Where the method of construction results in thermal bridges in external walls, the drop in the inside wall surface temperature at these points under cold conditions, is also calculated. If the interior surface temperatures at the thermal bridges (of houses constructed with the building system concerned) are assessed to fall below the surface temperatures of the standard brick house, and if the distribution and extent of such bridges warrant it, Agrément South Africa will assess the building system as being unacceptable from the point of view of condensation in the SCCP area of South Africa.

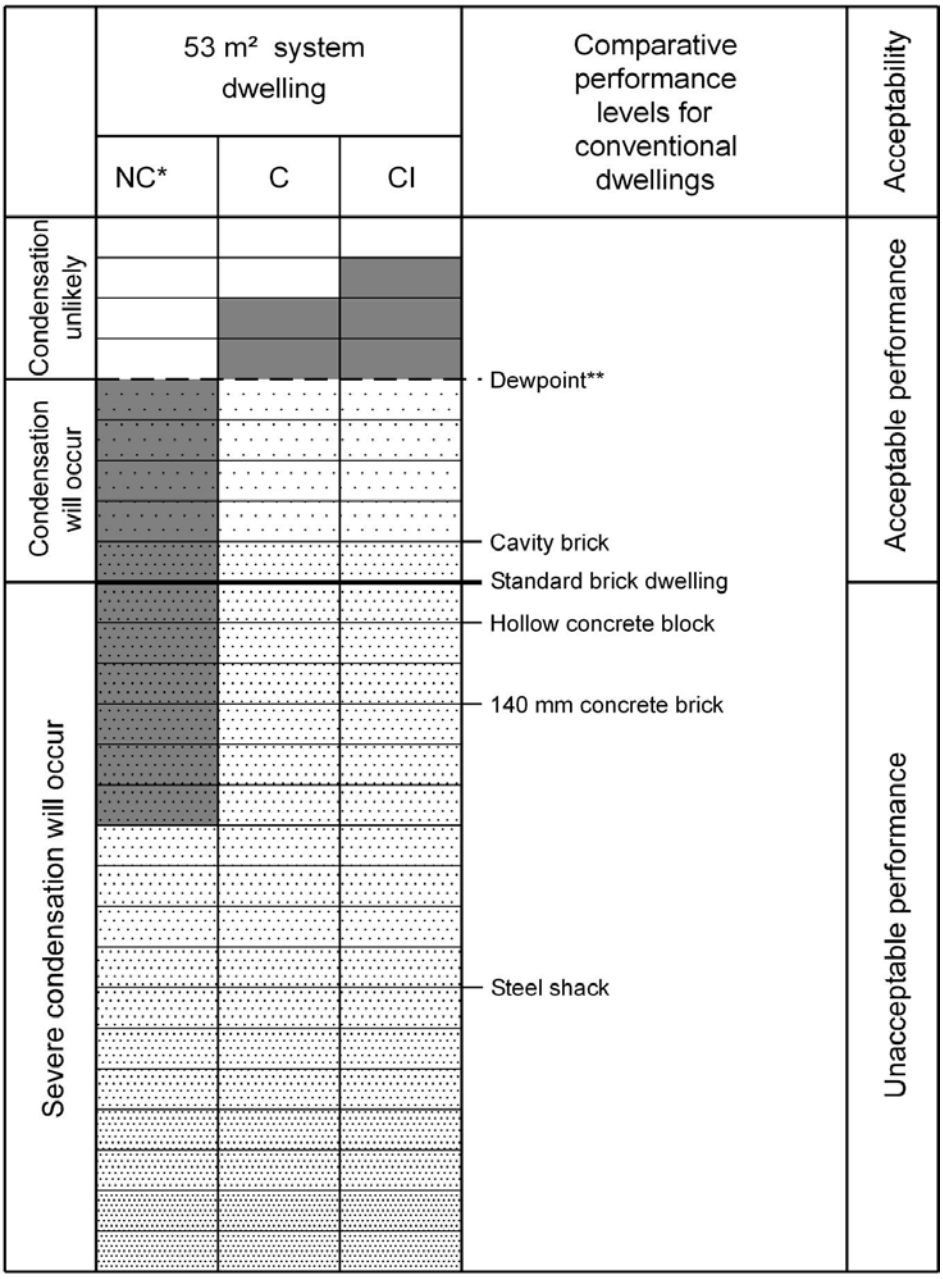
Recommendations

The general problem of condensation would be considerably reduced if the number of occupants in a dwelling unit were to be limited to the number for which it was designed.

The use of appliances that burn either paraffin or gas for cooking, heating or lighting should be avoided, except where the dwellings are properly ventilated.

Effective permanent ventilation which cannot easily be blocked by the occupants, should be provided in all dwelling units, or burglar bars provided, so that windows can be safely left open to provide the necessary air movement.

Table 3
Condensation: Comparative performance levels



NC — No ceiling

C — Ceiling

CI — Ceiling plus insulation

— — — Indicates the internal wall surface temperatures of the in-system dwelling in the SCCP area in relation to the performance of the standard brick houses.

* Where ceilings are omitted condensation will occur in winter on the underside of the roof sheeting and this will be a problem irrespective of the degree of insulation provided by external walls.

** Dew point - water vapour will condense on the walls when the surface temperature of these falls below the dew point temperature of the indoor air.

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