CONDENSATION PROBLEMS IN REHABILITATED PUBLIC SECTOR FLATS AND MAISONETTES

1. INTRODUCTION

Condensation and mould growth in poorly heated dwellings is a major problem in public sector dwellings, especially in flats and maisonettes. Occupants in affected dwellings often will also complain about a lack of thermal comfort and an inability or unwillingness to pay for fuel. The effect of rising fuel prices and publicity about energy saving has resulted in the first priority for any programme of rehabilitation being the provision of a cost effective heating system.

Clearly, all things being equal, adequate heating for thermal comfort will reduce the risk of condensation and mould growth. However, moisture generation and moisture vapour removal, either directly, or by general ventilation are equally important when assessing a problem of condensation.

Unfortunately there appears to be a commonly held view that ventilation is only a method of losing heat and should be reduced during the winter whenever possible. This paper considers problems in some recently rehabilitated flats and maisonettes.

2. CASE HISTORIES

2.1 Estate in LONDON BOROUGH of WESTMINSTER

2.1.1 Rehabilitation works

This estate was opened in 1961 and the part considered consists of two five storey blocks of brick-built maisonettes and ground floor flats. There was electric under-floor heating which was in some cases defective and generally not used because it was considered to be both ineffective and very expensive. There was a history of condensation and mould growth in a number of dwellings. The original windows were timber and they had decayed.

Due to financial constraints, the present phase of rehabilitation was limited to replacement of windows and some dry lining to the external walls. The new windows were draught-stripped, sealed

double glazed, plastic-coated steel units. One large light was openable. A permanent vent was provided at high level in the frame.

The ventilation of the dwellings was likely to have been reduced by the fitting of draught stripped windows. This, the double glazing and the additional thermal insulation was intended to make any heating system more efficient, in order to combat a condensation problem.

2.1.2 Observations

In fact the incidence of problems of condensation increased. Dwellings which previously suffered condensation experienced an increase in dampness problems and some dwellings which prior to the works had not been affected, now found unacceptable condensation.

2.2 Estate One in LONDON BOROUGH of ISLINGTON

2.2.1 Rehabilitation works

This is an eight-storey L-shaped, mainly brick-built block of 160 flats first opened in 1948. The construction involved cast concrete stair cases and a number of concrete lintels and beams. The original windows were steel framed and the heating system was a single gas fire in the living room.

The dwellings were provided with individual gas-fired hot water central heating systems. In addition, new UPVC tilt-and-turn double-glazed windows were fitted together with some dry-lining to solid concrete external walls and cavity fill to the brick infill panels. The windows were provided with permanent vents via a 'draught-free' unit in the frame. In addition the original air bricks in the living room were left.

2.2.2 Observations

Condensation problems continued to persist in some dwellings even in those which appeared to make reasonable use of the central heating system, eg. the system was on for a period in the morning and the late afternoon/evening and off for the daytime and overnight.

Mould growth formed on the corner of the cavity walls and also on window reveals and in an unheated toilet within about six weeks of the completion of the works. This was alleged to have happened in a number of dwellings out of the thirty or so completed. Observations were only made in three

dwellings due to the difficulty of obtaining access. It should be noted that these were made at the end of last winter and that by this coming winter many more dwellings will have been finished.

It is hoped that the fitting of bathroom and kitchen extract fans together with a catch that permits trickle ventilation around the perimeter of the openable windows will alleviate the extent of this potential problem.

2.3 Estate Two in LONDON BOROUGH of ISLINGTON

2.3.1 Rehabilitation works

This estate was first opened in 1936 and a rehabilitation scheme was carried out on a number of four-storey concrete framed and brick built blocks of maisonettes. The original heating system was coal fires in the living rooms.

The works consisted of installing:-

1. External thermal insulation to the blocks consisting of 50mm polystyrene protected by sand/cement render.

2. A "protected membrane" or "inverted" flat roof system consisting of 50 mm extruded polystyrene protected with paving slabs.

3. Replacement tilt-and-turn double windows.

4. Individual gas fired hot water radiators central heating.

5. A gas fire in the living room.

2.3.2 Observations

The dwellings had asphalted balconies to the living rooms which could not be insulated externally due to the limited space. The soffit in the bedroom beneath the balcony which was always a cause of problems with condensation appeared to be attracting even more condensation and mould-growth, even in apparently well heated dwellings.
In addition there appeared to be a greater incidence of condensation and mould-growth on the window reveals.

3. DISCUSSION

One of the first priorities in rehabilitation schemes is the provision of adequate thermal comfort. When heating systems are designed it is normal to reduce the conductive heat loss and the ventilation rate in order to save fuel and to reduce running costs.

However, the heating regime in most dwellings in London is intermittent. The heating may be on for about one to two hours in the morning and between about 1600 hrs and 2300 hrs in the evening. For the rest of the time the heating will be off. A dwelling heated in this way would be considered to be well heated within the normal expectations of the occupants.

Clearly, additional heat is available and this occasionally may be utilised during exceptionally cold spells. In public sector old peoples homes the heating is normally on 24 hours a day for the duration of the heating season (1 October through 31 March).

3.1 Ventilation

It is important to note that very little information is available about either the achieved ventilation rate in flats and maisonettes, or what ventilation rate is required to cope with the moisture of habitation. However, it is clear from the results of these and other recent case histories that the ventilation rate is inadequate for the lifestyle in the dwellings considered.

The most important source of water in the dwellings observed is probably from the drying of washing. There is normally no facility for this externally and washing is dried on radiators, in front of fires and radiators and in unvented tumble driers.

This factor, together with solid floors and a high density of occupation are, in my opinion, the major difference between flats and maisonettes and dwellings with individual private gardens.

The necessity to dry washing in dwellings with no gardens and without reasonable alternatives, is probably a major cause of condensation and mould-growth. Clearly, education of the occupants and/or the provision of suitable vented drying facilities would help alleviate this difficulty. Unfortunately, this is easier to say than to implement.

One major difficulty with condensation problems is that people are not very sensitive to humidity at a normal comfort temperature. Thus there may be no awareness of high humidity even when mould growth has been observed. In addition, people are often very sensitive to cold air currents, thus there

is often a reluctance to use ventilators or to open windows unless they produce draught-free ventilation.

The present design of windows ensures that when shut they will not permit water penetration, even through the permanent vent. I suspect that the air infiltration through the fully shut windows is very low, and that the equivalent area of the permanent aperture is significantly less than the dimensions of the external aperture. Clearly, the difficulty which remains is the design of a permanent ventilator that both provides a permanent draught-free airflow and cannot easily be blocked off by the occupant.

The use of bathroom and kitchen extract fans would both remove moisture at source and increase the ventilation rate. For this reason it has been suggested that fans should be fitted as a matter of course in rehabilitation work. However, fans are often not used and even specifically blocked by some occupants. There is also a reluctance to use fans on the part of other occupants because of the loss of heat and a misunderstanding of their low running cost.

The present problem of continuing condensation and mould-growth in apparently well heated rehabilitated dwellings could be alleviated by increasing the ventilation rate. As part of the rehabilitation program appears to be specifically intended to reduce the ventilation rate in order to save energy, it would seem necessary to reconsider this approach, particularly when considering dwellings with no vented facilities for drying washing.

3.2 The use of windows to provide ventilation

It is often the case that permanent vents and openable windows are the only significant source of airflow within a flat or maisonette type dwelling. Floors are normally solid, chimneys, if they did once exist, are sealed, or their apertures very much reduced and windows and doors are often draught-stripped. These features are considered to be desirable in terms of reducing energy needs.

Permanent vents are generally considered undesirable in terms of producing draughts and wasting heat and in the past, have been designed according to the provisions of the Inner London Building Regulations based upon the size of the external aperture. The National Building Regulations for England and Wales do not have a general requirement for permanent appertures in habitable rooms and this may lead to further increases in the incidence of condensation in London when the Inner London Building Regulations are withdrawn.

It is my opinion that some draught-free permanent vents, which involve a tortuous path through the window system may have a less than expected equivalent area.

This means that in practice some of the present designs of permanent vents may not provide the intended permanent aperture. However, the systematic sealing of other additional sources of ventilation probably is more significant in reducing the overall ventilation rate.

Irrespective of whether there is considered to be adequate provision for permanent ventilation, the evidence from the dwellings considered above is that the ventilation is, in practice inadequate. As the main source of airflow is through the window system, it would seem reasonable to consider modifications to windows.

In my opinion the absence of fanlights on the present windows is a cause of difficulty. Tilt and turn windows are used to enable the occupant to provide ventilation in the tilted position. However, some occupants have complained that the resultant air-flow produces draughts at head height when seated.

Some window systems now have the facility of a position on the catch that produces a small gap around the draught stripping to provide trickle ventilation. It may also be possible to modify existing windows to provide this facility.

Occupants tend not to make alterations to window positions without a strong stimulus. Thus, occupants will have a preset position for their windows and only when there are very significant changes in the internal or external environment are modifications made to the window positions.

Clearly, if an occupant believes that windows should always be kept tightly shut, possibly a reasonable interpretation of current energy saving publicity, then the only available ventilation is via the permanent apertures in the structure.

An occupant may wish to have ventilation but can be inhibited from using the facilities provided if the open window produces unacceptable draughts. This could be prevented by the provision of a high-level variable aperture opening. In my opinion this facility would be best provided by a fanlight.

It is worth noting at this point that external noise and/or air pollution may also inhibit an occupant from opening windows and thus result in an unacceptably low ventilation rate for the habitation. This can produce mould growth and condensation.

3.3 Design of windows

Whichever windows are used, it is inevitable that some life styles will result in condensation and mould growth. Amongst objectives of rehabilitation of dwellings is a reduction in the number of dwellings affected by these problems.

It is most important to provide the occupants with as many options as possible with respect to the use of windows. The following points are recommended:-

1. All new draught-stripped windows should be provided with a facility for a secure opening position where air can by-pass the perimeter sealing.

2. Wherever practicable, an openable fan-light should be provided. If this is not possible, a variable opening ventilator should be provided at high level.

3. The performance of permanent vents in windows should be examined in order to determine whether sufficient equivalent area is provided.

4. The size of permanent vents in windows should be considered with respect to different types of dwellings. Flatted dwellings are liable to require a greater area of permanent window vents then individual houses.

3.4 Thermal insulation

Increasing the thermal insulation reduces the steady-state heat loss and can reduce the cost of maintaining thermal comfort. However, when the objective is the alleviation of condensation and mould-growth, it is the effect of thermal insulation on the thermal diffusivity of the surface that is important.

Most lifestyles, other than old people's homes, tend to have intermittent heating as described above. Thus the average daily temperature may be comparable to the maximum dew-point temperature.

If a dwelling has uninsulated concrete or solid brickwork for any of its internal surfaces, the time constant and high thermal diffusivity of the surface means that there is a high risk of condensation. The fairly constant temperature of the surface and the need for additional heat to evaporate any condensate formed means that this type of surface tends to stay damp, creating conditions suitable for mould-growth.

If external thermal insulation is fitted as a remedial measure it may have little effect in alleviating a problem of internal condensation on dense heavy materials in intermittently heated dwellings. Intermittent heat, as described above, is likely to be insufficient to raise the overall temperature of say, 225mm dense concrete to above the maximum dew- point temperature produced during occupation.

This means that the internal dry-lining of concrete or solid brickwork has to be considered as a method of alleviating the effects of condensation in spite of the risk of future interstitial condensation. Clearly, this risk can be reduced by the use of a vapour check.

When windows are double glazed and/or internal surfaces are thermally insulated, the overall rate of formation of condensate is reduced and the internal humidity is increased. Thus, if in the rehabilitation some dense materials have been left uninsulated on their internal surfaces such as window reveals, concrete soffits or concrete beams, then the risk of condensation on these surfaces may be increased.

3.5 Comments on the observations

The observations made on the rehabilitated dwellings are consistent with the ventilation being reduced. The additional thermal insulation may have exacerbated condensation and mould-growth on some dense surfaces, but in my opinion it is the reduction of ventilation rate that is the major factor.

Any problems that may have been caused by increasing the thermal insulation could be alleviated by increasing the ventilation rate.

4. CONCLUSIONS

The ventilation rate achieved in these dwellings after rehabilitation is too low for the lifestyle. However, the extraction of moisture at source and/or the provision of facilities for the drying of washing is an alternative approach to a general increase in ventilation rate.

There is a need for more data on the ventilation rates achieved in dwellings and for guidelines on minimum ventilation rates in different types of dwellings. Such recommendations should include methods for their achievement.

New windows should have fanlights and the facility to provide draught-free trickle air- flow. In addition, occupants should be made more aware of the need for adequate ventilation and discouraged from blocking any of the permanent apertures provided.

Additional external thermal insulation may have only a limited use in alleviating a problem of condensation and mould growth in intermittently heated dwellings.

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