#5395

A transparently insulated terraced house in the UK

K.A.Johnson
Pilkington Insulation Ltd.,
P.O. Box 10, St. Helens, WA10 3NS U.K

ABSTRACT

A mid-terrace house near St. Helens, England, is being clad in transparent insulation; the front faces roughly SE and the rear elevations face roughly NW and SW.

The insulation is to be fixed using proprietary uPVC framing and will be protected by toughened float glass; venting/decoupling will be provided to the insulation/wall area and a condensate gap and drain to the insulation/glass area.

The main purpose of the test is to determine what conditions are created throughout the house, which is inhabited. Particular attention will be paid to solar gain/overheating at the front and to any internal surface temperature increases at the rear which might alleviate condensation and mould growth problems. Monitoring to cover summer and winter conditions will comprise measurement of solar insolation and ambient conditions, heat flows, and internal and external surface temperatures; these will be compared to computer predictions for the various parts of the building. Double glazing (where possible) and a high level of loft insulation will be provided as well as some external opaque insulation where appropriate.

INTRODUCTION

In the U.K., condensation is a major housing problem, affecting some 3.5 million homes; of these, it is estimated that 1.5 million are seriously blighted. The basic reason is that the houses are not heated sufficiently and fabric losses are high, resulting in cold exterior envelopes. This is exacerbated by an understandable tendency to underventilate, keeping internal air moisture levels high.

If these houses were clad in transparent insulation material (TIM), the internal surfaces of exterior walls would be warmer because of a combination of effects: the walls would be directly heated by the solar energy, rather than being warmed from the interior environment and that environment itself would be warmer because of reduced heat losses and increased heat input. The end result must be a dramatic reduction, if not elimination, of surface condensation as well as the obvious increase in comfort levels, with no increase in running costs to the tenant. Thus a major potential use for TIM exists in upgrading these houses.

THE HOUSE

In conjunction with the housing association Merseyside Improved Houses, an occupied terraced house is to be clad with TIM to investigate its effects. The floor plan is given in Fig 1 and is fairly typical of the type of house frequently found to suffer from condensation, although this particular one is not seriously affected. That may be because it is more usual for the two ground floor rooms in the body of the terrace to be living rooms and for the bathroom to be above the kitchen in the outrigger (the rear 'extension'). In affected houses, condensation frequently occurs in these two moisture producing areas which are usually unheated, receive little heat transfer from the living room(s) and have a large exterior wall surface; in this house, these rooms also receive little solar gain.

The house faces approximately SE and the rear has walls facing approximately SW and NW; the adjoining house (referred to later) has rear walls facing approximately NW and NE.

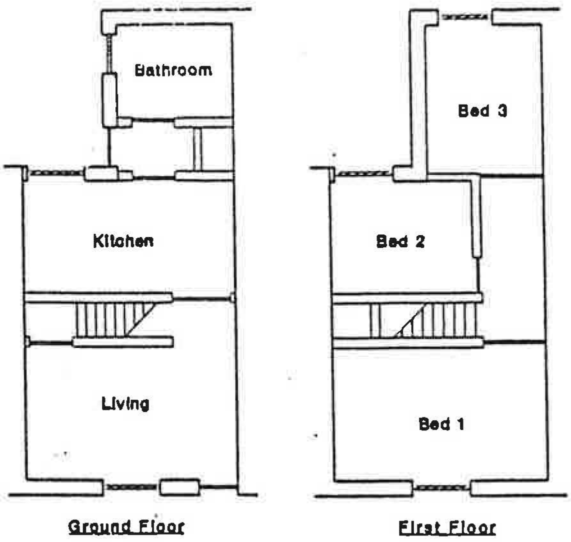


Fig 1. Floor Plans

OBJECTIVES

Since cladding a house with TIM would be an expensive upgrade, the main objective is to look for major beneficial effects to justify that cost, but not necessarily in strict cash terms. The usual energy saving approach of attempting to reduce consumption is not applicable here; the desire is to improve comfort conditions by raising internal temperatures and reducing condensation risk, which are difficult to cost. In addition, possible side effects will be looked for such as summer overheating of rooms facing towards the south and increased thermal differentials between northerly and southerly rooms which could possibly increase condensation risk.

DETAILS

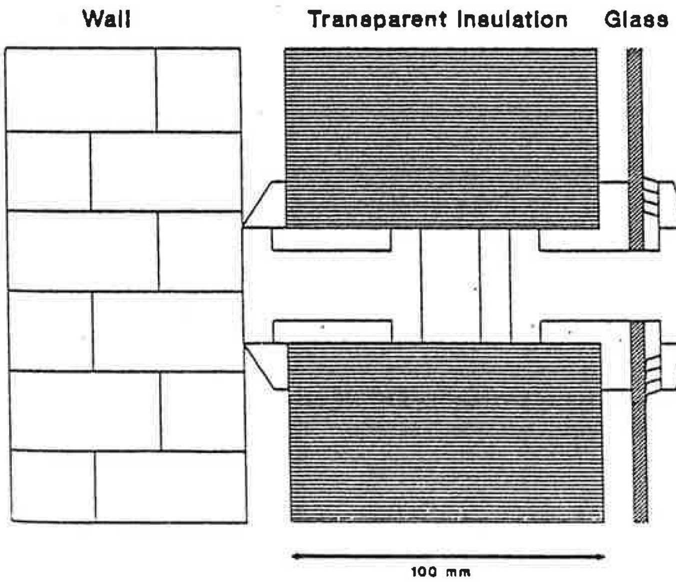


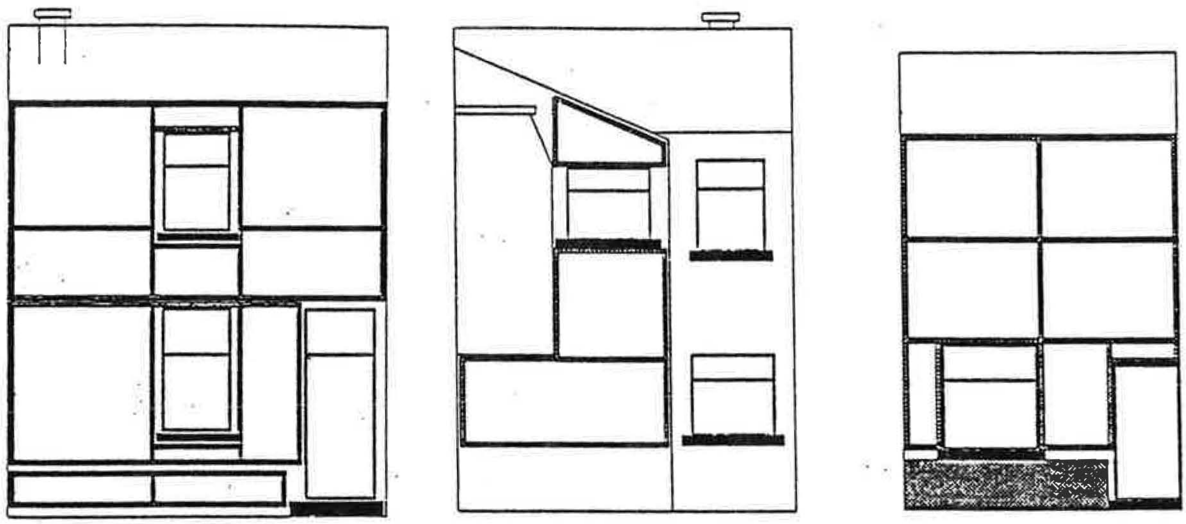
Fig 2. Section of Frame

Arel polycarbonate honeycomb has been chosen as the TIM; it is assembled into blocks 100 mm thick and contained behind toughened float glass in a uPVC framing system, Fig 2. A 7 mm gap between glass and TIM should keep any condensate clear of the honeycomb and allow it to drain away via slots; an 18 mm gap between honeycomb and wall increases the insulation value and can be vented if required. uPVC is being used because it should not require maintenance, it will allow any moisture to clear quickly (that is, moisture will not be absorbed), and it has a low thermal conductivity. The frame is made up from available sections and therefore is not intended as a final design.

No control of heat input and loss, such as blinds, is being incorporated into the construction. This is because of the capital cost and a general resistance to active systems and associated need for maintenance and repair. Hence there is some concern about summer overheating.

On the southerly facade, the whole available area is being clad with TIM to obtain the maximum heat input to the property Fig 3a; on the northerly side, there are areas to be left blank, to be clad with TIM and to be clad with conventional 'opaque' insulation for comparison purposes, Figs 3b & 3c.

Fig 3. Frame Positions



(a) SE Facade (b) NW Facade (c) SW Facade
(Shading = Opaque Insulation)

A number of practical problems have been encountered. Steps or features in the brickwork have necessitated extra subdivisions of panels or cutting away of frame material. The size and shape of the walls, and the juxtapositions of windows and doors have dictated purpose-sized frames. Standardisation would only have been possible with very small frames which would incur extra cost and reduce performance. It was necessary to move a telephone cable and various pipes and some areas will remain uninsulated because of other problems. An old chimney stack has also reduced the available useful area and airbricks have required special consideration.

To compliment the TIM cladding, the loft insulation has been increased to 200 mm of glasswool and the windows have been double glazed. Again practical problems limited what could be done: in the loft, construction details limited some areas to 100 mm of wool and about one third of each window has been left single because louvres are used for ventilation in the absence of opening lights.

No action has been taken concerning air flows within the house, but this aspect may need consideration to balance north/south temperature differences or summer overheating.

MONITORING

The adjoining house has also been made available for monitoring, so some comparisons will be possible between TIM clad and unclad properties. However, it is recognised that occupancy levels and usage patterns will be different and also the houses are mirror image, so solar gains and wind effects will be different for the northerly sides of the properties.

Monitoring will be as follows:-

External temperatures, humidity and windspeed; solar irradiation (horizontal, and SE and SW vertical surfaces)
Internal temperatures - all six rooms, both houses.
Internal humidity - bathroom only, TIM clad house
Internal and external surface temperatures and heat flux of external walls as follows:

- SE face - at two positions on the TIM clad house and two comparable positions on the unclad house.
- NW face - at one comparable position on each house plus one position on the uninsulated area on the TIM clad house.
- SW/NE faces - at one comparable position on each house plus one opaque-insulated position on the TIM clad house.

In addition, a note will be made of the pattern of use (and energy consumption) of the gas fire in the living room of the TIM clad house which is the only source of heat currently used.

PREDICTIONS

Predictions are yet to be made of the effect of TIM on air and surface temperatures within the dwelling when there is little conventional energy input. An estimate has been made of the effect on energy consumption if the dwelling was to be kept at 18°C. Without the TIM, the building has a design heat load of 275 W/K and as such would need 13800 kWh for a years heating. With the TIM (but excluding the double glazing and extra loft insulation) consumption should drop to 2400 kWh. Three quarters of the saving would result from cladding the southerly facade, and the other quarter from the northerly facade. Since the two facades are of approximately equal area, some extra benefits are looked for to justify the cladding of the northerly facade. Calculations for a north wall indicate that with maintained internal temperatures, there could be a possible 2 to 4 °C increase at the internal surface. That could be significant in its effect on condensation risk, since it represents very roughly a doubling of the allowable vapour pressure excess in the dwelling (over the external environment) for the same risk. Clearly therefore, for the same vapour pressure excess, condensation risk should be dramatically reduced.

PROGRAMME

The houses will be monitored for a period of at least twelve months during and after which results will be analysed.