Improvement of existing windows

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Windows in old blocks of flats have been studied in respect to draught-proofing and heat flow. The measurements of draught-proofing show that the majority of the windows are not well draught-proofed. Measurements have been carried out on old windows before and after the renewal of the draught excluders between the window frame and the casement. These experiments show that the draught-proofing can be very much improved with new rubber draught excluders and with precise adjustment of casements and window fasteners. The measured U-values of double-glazed windows corresponded to an average of 2.40 $W/m^{2o}C$ in the middle of the pane. Two different systems of converting double-glazed windows into triple-glazed windows have been studied in the laboratory. These experiments show that the U-values were improved by 25-30%.

Amelioration des caracteristiques thermiques des fenetres des habitations anciennes.

On a étudié les fenêtres dans les immeubles collectifs anciens en vue de serré contre coulage d´air et en vue de transmission de chaleur. Les mésures de la imperméabilité de l´air indiquent que la majorité des fenêtres sont mauvaises. On a mésuré le coulage entre le chambrale et le dormant des fenêtres avant et après rebourrage. Des bourrelets neufs et un reglage dispositif de fermeture fait du bon. Les valeurs de k obtenues pour des doubles vitrages se situent autour de 2.40 $W/m^{2o}C$ au milieu du battant. Il y a presenté deux systèmes différents de survitrage d´une vitre supplémentaire de transformer les doubles- en triples-vitrages. Ce survitrage diminue d´environ 30% la conductibilité thermique des fenêtres.

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The results of the measurements presented below are part of the research project entitled "The Saving of Energy in Existing Blocks of Flats by Means of Building-technology Measures". The project has been sponsored by the National Swedish Council for Building Research.

The project has concerned blocks of flats built during the period between 1860 and approx.1960. Surveys have been concentrated on three different towns in Sweden - Malmö (large city), Eksjö (a town of timber houses) and Gävle (a town in the northern half of Sweden).

Measurements of draught-proofing of windows

The draught-proofing of the windows was measured according to the so called "guarded pressure box" principle. This means that with the aid of fans, an over- or underpressure is created on the inside of the window in relation to the outside. As a result of the difference in pressure between the two sides of the window, air will flow inwards or outwards through cracks in the window. The volume of air flowing inwards or outwards is recorded. In this way the amount of air leakage through the window, created by various pressure differences, can be determined. The volume of this air leakage is obtained as a function of the pressure difference between the inside and the outside of the window.

Totally 21 windows were investigated. The results of this investigation are illustrated in Figure 1. In the figure the air leakage of the windows can be compared to the air leakage of a modern window. The figure shows that the majority of the windows are not well draught-proofed. Only three windows are draught-proofed to an acceptable level.

According to new standards (Swedish Building Code, 1975, SBN, 1975, Supplement 1) the leakage of air through new windows should not exceed 1.7 m^3/m^2 per hour with a pressure difference of 50 Pa (5 mm vp) and 5.6 m^3/m^2 per hour with a pressure difference of 300 Pa (30 mm vp) respectively. Among the windows examined, only two windows meet this requirement. The other windows are above this level.

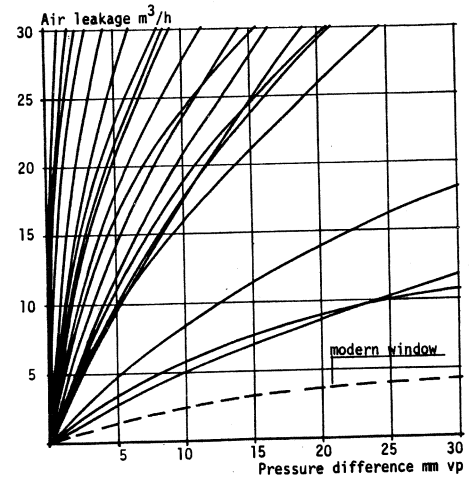

Figure 1 The air leakage of the investigated windows. Overpressure on the inside of the windows.

In order to find out if the draught-proofing of old windows can be improved, measurements in the laboratory and in the field were carried out before and after the renewal of the draught excluders between the window frame and the casement. These experiments show that the draught-proofing can be very much improved with new rubber draught excluders and with precise adjustment of casements and window fasteners.

As an example, one of the investigated windows is shown in Figure 2. The figure illustrates the air leakage between the window frame and the casement when there is overpressure on the inside of the window. The window had a center mullion and two outward-opening linked casements, a usual type of window in the 1940's.

The figure shows that the window in its original condition, with draught excluders made of foamed plastic, is rather draughty. After the renewal of

the draught excluders, the window as become 60% less draughty. The casements were then adjusted in the window-frame and, compared with the original condition, the window has become over 85% less draughty. The window now fulfills the requirements according to SBN 1975. The diagram shows clearly the importance of adjusting the casements.

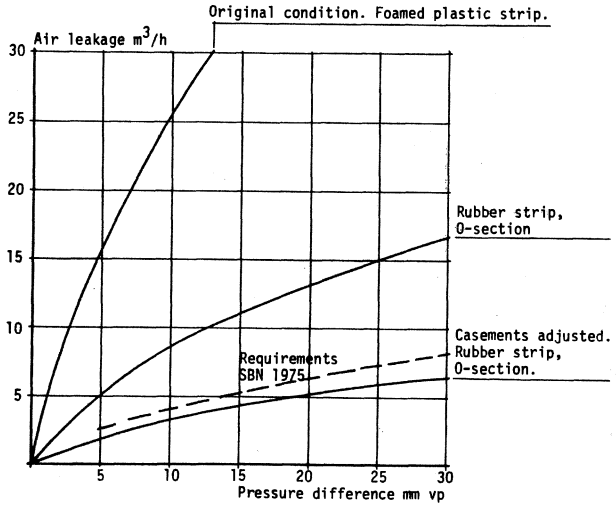

Figure 2 The air leakage before and after the renewal of the draught excluders. Overpressure on the inside of the window. Outward-opening linked casements. Window-area 1.44 m^2.

From the experiments it appears that old windows can be fully acceptable in terms of draught prevention. This means that energy can be saved by just checking the condition of windows. Improvement of the draught-proofing of windows often has a double energy-saving effect. Not only is the leakage of heat prevented, but the draught from windows also disappears. This makes the indoor climate more comfortable, with the result that the indoor temperature can often be lowered a few degrees.

Measurements of heat flow through windows

The heat flow through the windows has been measured with the aid of heat flow meters. These have been placed in the middle of the pane. Totally 18 windows were investigated. All were double-glazed windows. 11 windows had linked casements and 7 windows had double non-linked casements. The measured U-values of the windows corresponded to an average of 2.40 $W/m^{2o}C$.

Two different systems of converting double-glazed windows into triple-glazed windows were studied in the laboratory. The systems were studied in respect to heat flow. In the first system the third pane is placed on the inside of the window. The pane is mounted in a frame made of PVC, which on one side is screwed to the inner casement. This side of the frame is hinged. The other three sides are fastened to the casement with special fasteners. This means that the pane can be opened for cleaning (Figure 3).

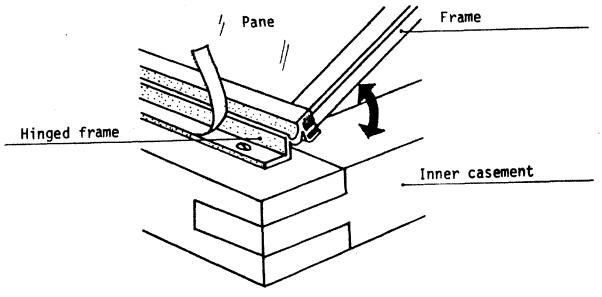

Figure 3 The third pane is mounted on the inner casement.

In the other system the pane in the inner casement is replaced by a sealed glazing unit, double glazing. The double glazing is mounted in the inner casement with the aid of aluminium profiles (Figure 4).

These two systems were mounted on an outward-opening window with linked casements as well as on an inward-opening window with linked casements. Both windows were of the same size.