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IMPROVING THE SOUND INSULATION OF GLAZED PARTITIONS

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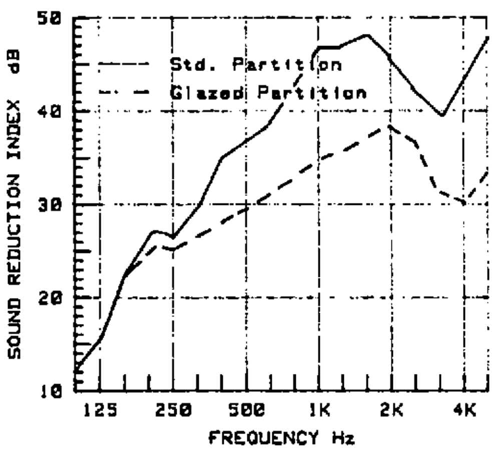
INTRODUCTION

There may be occasions when the total office landscape is visually desirable and yet for some occupants acoustical privacy remains essential. Glazed office partitions, thoughtfully designed and engineered can satisfy both the criteria but all too frequently these partitions fail to meet the acoustic requirements (Fig 1).

FIGURE No: 1



Offered as an option in a standard partitioning package the more common arrangement utilises a simple timber, metal or plastic frame in which is held, usually by neoprene gaskets, single or double glazed panels of monolithic glass.

As part of an ongoing development programme the performances of a variety of glazing systems including monolithic, laminated and sealed units have been established and these include a number of systems which can give optimum performance in internal partitions.

Additional tests carried out under controlled conditions with similar frames constructed from a range of materials have shown that the choice of frame material is of little consequence in determining the system sound reduction index.

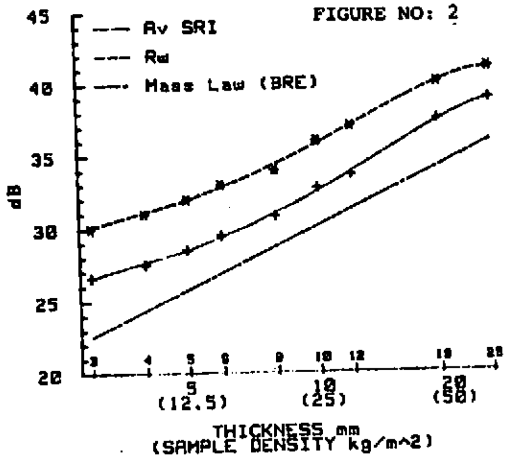
However the tests have also shown that optimum performance is not always achieved if gaskets are used instead of mastic putty.

The object of the paper is to present and discuss some of the results of the development programme relevant to internal partition design.

MONOLITHIC GLASS

A simple approach to deciding the glass required for a given situation is to use the empirical mass law, examples of which are given in many acoustic text books. In general these curves tend to overpredict for materials of low density and underpredict for materials of high density. Monolithic float glass (density $2.5 \times 10^3 kg/m^3$) is a high density material. The laboratory measurements made over a variety of thicknesses from 3 to 25mm indicate that practical mass law underpredicts glazing performance. Figure 2 compares the averaged measured SRI and that predicted using mass law [1]. Also shown are the corresponding values of R_w index.

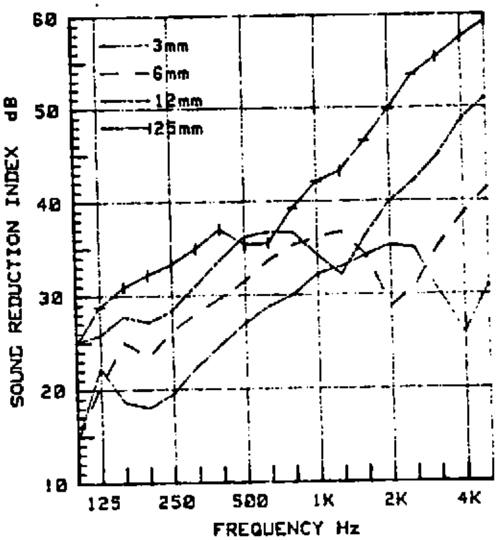
FIGURE NO: 2



A_v SRI = 23.5 + 1.1t - 0.02t²
glass

t = thickness in mm

FIGURE No: 3



Mass law has limitations and particularly with glass attention has to be paid to the coincidence region, the frequencies at which the projected wavelength of incident sound on the glass panel equals the wavelength of free bending waves in the panel. Here efficient coupling takes place between glass panel and air resulting in a loss of insulation. The lowest frequency at which this occurs (critical frequency, sound at grazing incidence) is given by

$f_c = \frac{12}{h}$ Hz h = thickness of glass in metres

Examples of this effect are given in Figure 3 and it can be readily seen how, with the thicker glazing, the insulation is reduced in the important mid frequency bands. It is important to avoid choosing a glass thickness whose characteristic coincidence resonance corresponds with a dominant component of the source noise.

PATTERNED GLASS

Patterned glass is used extensively in internal partitions to allow light penetration but with visual privacy. The acoustic performance can be readily predicted from 'mass law' and the coincidence frequency can be inferred from mean thickness. Figure 4 shows the performance of a single sheet of nominally 6mm deep flemish glass. The coincidence frequency is the same as that expected from 5mm clear float glass.

LAMINATED GLASS

Laminated glass is another measure being introduced by partition manufacturers and installers as a safety development. It is often preferred to 'toughened' glass since it can be cut to size on site. There are some acoustical advantages at resonances particularly coincidence and low frequency where the inherent damping of the laminate improves the insulation. There appears to be little

FIGURE No: 4

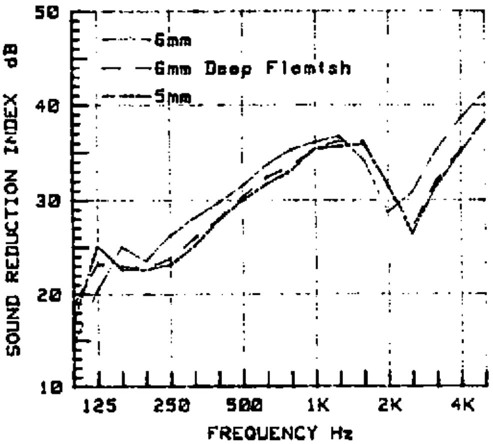
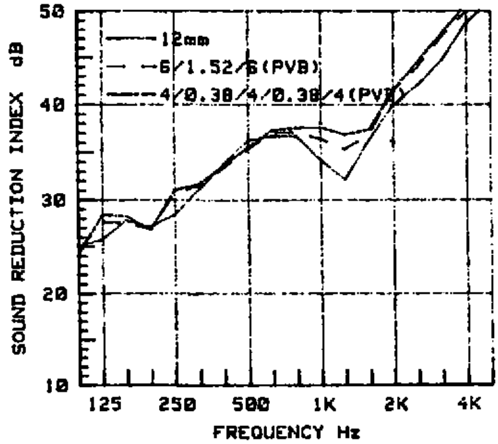


FIGURE No: 5



additional advantage however in going to a double laminate (Figure 5). The choice of laminate material is important and Figure 6 illustrates the difference between the traditional PVB laminate and the softer methacrylate based interlayers. These tend to exhibit the coincidence resonances corresponding to the individual glasses rather than those of the composite. The performance of these plastic laminates is temperature dependent as described in a recent paper [2]. The thickness of the laminate has only a small influence (Figure 7). It is possible to laminate patterned glass with predictable results (Figure 8). For applications where there is a potential fire hazard special laminated glasses have been produced with interlayers of borosilicate (eg Pyrostop). These still

FIGURE No: 6

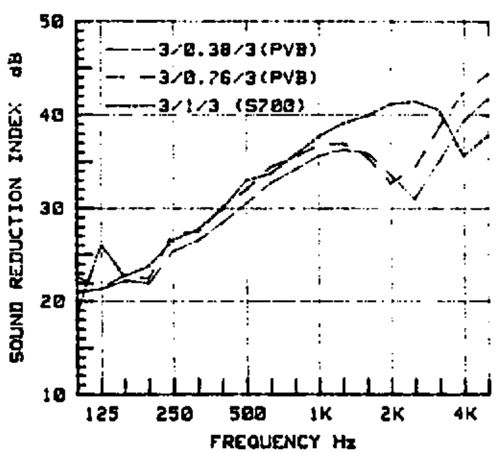
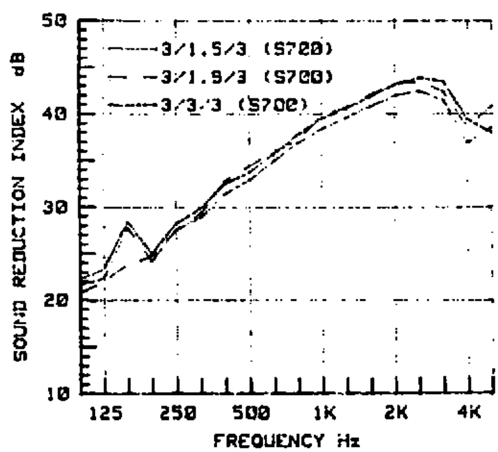


FIGURE No: 7



provide the advantages of a laminate with extra damping at resonance (Figure 9).

FIGURE No: 8

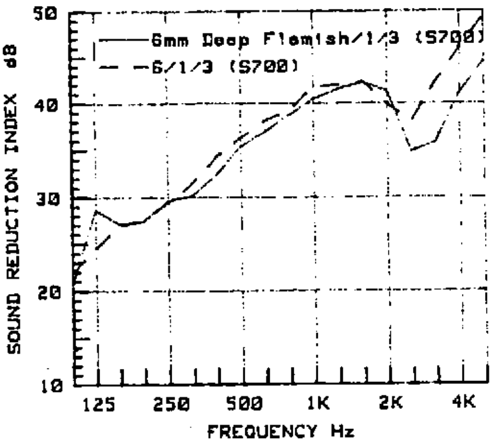
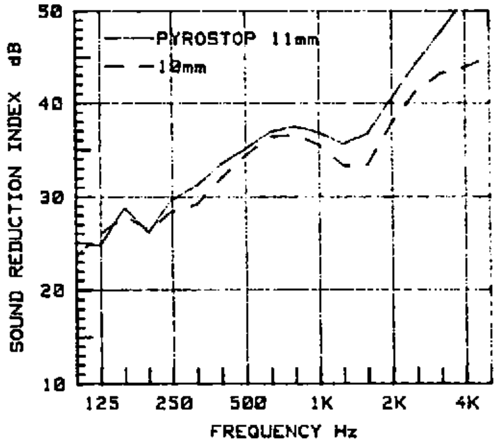


FIGURE No: 9



DOUBLE GLAZED UNITS

For most applications either single glass or laminated glass offer adequate solutions but for those installations which divide areas of different temperature then double glazing may be the preferred solution. The acoustic performance of a double glazing unit cannot be predicted by mere consideration of its total mass, the associated resonances are very different from a single glass of the same weight. This is illustrated in Figure 10. Double glazing units have been developed with laminated glass which exhibits significant improvements in acoustic performance. However detailed discussion is not appropriate here.

FIGURE No: 10

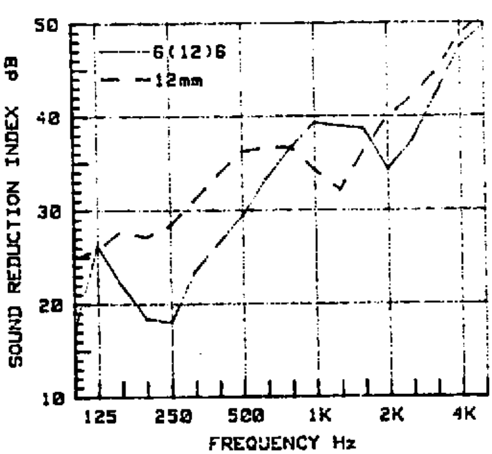
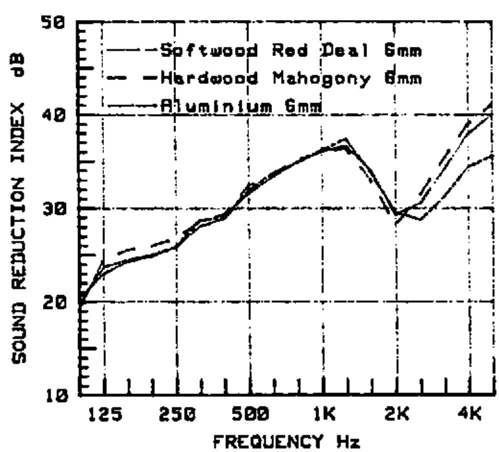


FIGURE No: 11



FRAMES AND MOUNTING

Much has been written particularly in the popular press about the advantages one type of frame has over another. We are here concerned with acoustical advantages and for internal partitioning without opening lights controlled tests have shown there is little advantage in any material (Figures 11 and 12). Differences that occur do so in the low frequency and coincidence resonance regions and can equally be attributed to edge damping. This particular topic is currently under examination.

FIGURE No: 12

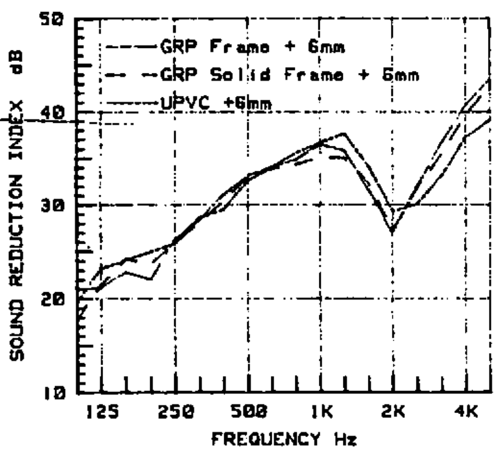
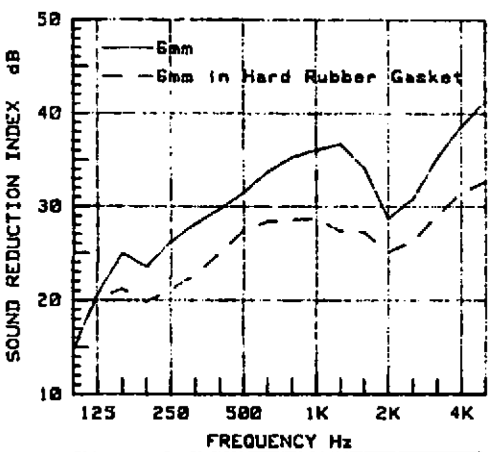
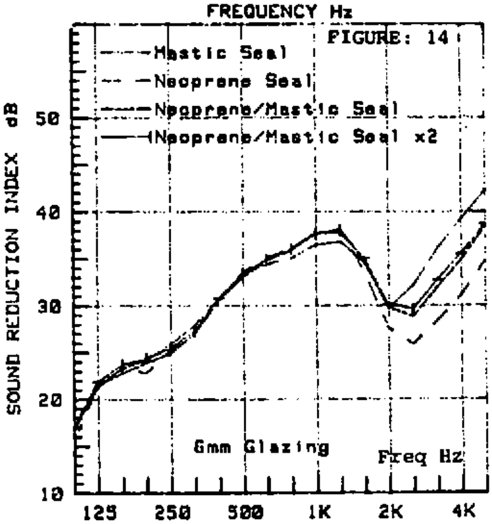


FIGURE No: 13



Perhaps of greater importance in achieving satisfactory performance is the effectiveness of the mounting seal. The hard rubber gasket common in many internal partitions hardly seals at all (Figure 13) and is usually the cause of the poor insulation of the glazed partitions depicted in Figure 1. Normal laboratory practice is to use mastic putty as the glazing medium. Departures from this method usually show lower sound insulation. This aspect was examined by installing the same glass in seals of varying efficiencies. The results are shown in Figure 14. The glazing was installed initially with a soft neoprene seal and then this was progressively improved by adding a capping of mastic to one and then both sides. This latter technique is one adopted by the Scandinavians for sealing external glazing but even this did not perform as well as the mastic used above. This result suggests that the density



of the seal as well as its flexibility is important.

CONCLUDING REMARKS

An important consideration in partition design is the internal noise level target. This will depend upon the tasks which are being undertaken in the enclosed space (eg offices, classroom etc) and the best solution is not necessarily that which produces the lowest noise levels. Open plan offices for instance benefit from having a degree of background noise present to preserve privacy and to avoid undue disturbance from internal sources. When using partitions with large glazed areas the techniques outlined above will permit a greater degree of flexibility in design and allow the insulation to match the circumstances.

REFERENCES

[1] E.N. Bazley, "The Airborne Sound Insulation of Partitions", H.M.S.O., 1966.

[2] R.D. Ford and G. Kerry, "Temperature effects on the sound insulation of laminated glass", Proc. 11 ICA. 7.3. 1983