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THE EFFECT OF LEAKAGE ON THE SOUND INSULATION OF PLASTERBOARD CONSTRUCTIONS

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INTRODUCTION

Lightweight partitions and floor systems can be designed to give high levels of sound insulation and with careful design of flanking structure, high levels can be achieved on site. However, an important aspect of detailing often overlooked is the sealing of these elements which if not done correctly can result in a devastating loss of sound insulation. The discussion looks at leakage with respect to these elements.

Line of sight leakage

In the case of a hole right through a partition or a crack at the perimeter, it is assumed that by comparing the relative areas and transmission coefficients, the composite sound insulation can be calculated. It is well known that a tiny proportion of such leakage gives the spectrum a characteristic flattening off at high frequencies but no losses at lower frequencies. A typical example is that of a metal stud partition with no sealant under the base track which when sealed the weighted standardized level difference Dntw increases from 44 dB to 49 dB - Fig. 1. A second example is a metal stud partition with no sealant under the base track giving weighted sound reduction index Rw 34 dB and 55 dB when sealed - Fig. 2. A third example is a partition with a door in it. When the door has no perimeter seal the Rw of the composite is 28 dB and 42 dB when the door is taped up around the perimeter - Fig. 3. Again the spectrum exhibits a plateau at middle and high frequencies. This type of leakage can be called "line of sight" leakage since one can virtually see through the partition into the next room at the leakage point. The cure is to seal it as effectively as possible, but until a completely airtight seal is achieved, then a loss of insulation at high frequencies occurs.

Cavity leakage

A construction comprising a framework lined each side with plasterboard or chipboard can suffer another effect from leakage whereby one leaf may be correctly sealed around its perimeter but not the other. The sound can therefore enter the cavity and even although there may be a glass wool mat present, the sound insulation is degraded. A timber joist floor with the chipboard unsealed around the perimeter had an Rw of 50 dB and when the perimeter was sealed the Rw became 54 dB. The comparison of spectra in Fig. 4 shows losses at all frequencies and much less of a plateau effect. A partition with no sealant at the base but the base track sealed i.e. excluding "line of sight" leakage gave Rw 45 dB and 55 dB when correctly sealed - Fig. 5. A second partition incorrectly constructed from previously used studs allowed the boards to be slightly kept off the base track due to the earlier screw holes having burred the metal. The Rw was 41 dB and 48 dB when this source of leakage into the cavity was prevented by using new studs and applying sealant - Fig. 6. The nature of this leakage is much harder to diagnose when trying to explain why a lightweight partition has failed to achieve its potential sound insulation. The lack of plateau effect seems to rule out the usually accepted consequence of leakage yet it has occurred nonetheless.

The effect of fitting a skirting

A partition constructed with no base sealant at all gave Rw 34 dB (its potential was 55 dB). When a timber skirting was fitted each side the Rw rose to 44 dB. Fig 7 shows the interesting spectrum shapes that may occur and it can be appreciated that identifying these problems in practise can be difficult. The same partition with the base track sealed down but still allowing "cavity leakage" gave 45 dB with no skirting and 50 dB with the skirting - Fig. 8.

Electrical sockets

From the above it may be thought that "back to back" sockets would be taboo. The 55 dB partition above had two double "back to back" sockets boxes fitted with a hole in the back of each socket box pressed out. The front covers were fitted and no sealant around them was used. The Rw was 54 dB as seen in Fig. 9. Another high performance partition of Dntw 49 dB had sockets boxes fitted and yet the Dntw dropped by only 1 dB - Fig. 10. Thus the surprising fact emerges that the sound insulation is hardly degraded. This may be because there is a difference between a leakage path being a perimeter crack or a hole right through the wall. For example in Fig. 11, the spectrum is shown for the wall above with the socket box hole cut in one side of the wall and then both sides. The Dntw is 47 dB and 43 dB respectively and although the spectrum is flattened off when the hole is right through, (The plateau height calculated on an area ratio basis is 31 dB when then the hole is right through - the fact that this was not seen is possibly owing to the transmission loss of the 80 mm glasswool mat having been ignored.), the effect of the hole one side is minimal. This must be because the studs effectively compartmentalise the partition into 600 mm modules and thus although one module is degraded the total partition is substantially unaffected. Perimeter leakage obviously affects all the framework modules. Another test on a wall with a 16 mm inside diameter tube right through the middle of the wall gave Rw 44 dB and 47 dB with no tube - Fig. 12. The curve tends to plateau and the calculated level based on the area ratio is 46 dB. In addition, the tube gives a large loss in insulation at 1250 Hz of 18 dB.

CONCLUSIONS

1. If the base track of a lightweight partition is not sealed and no further sealing of the boards at the base is carried out then a devastating loss of sound insulation occurs. This can be diagnosed from the spectrum shape and listening tests.

2. If the base track is sealed but the boards are not sealed then cavity leakage occurs which has the effect of reducing the sound insulation at all frequencies. This is almost impossible to diagnose unless the skirting is removed. The remedy is to seal the skirting to the wall with sealant or remove the skirting and completely fill the gap at the base. This would also

apply to timber joist separating floors where sound could enter the cavity at the perimeter of the chipboard.

3. Electrical socket boxes, even back-back do not appear to present a problem with sound insulation.

4. A hole right through a cavity wall flattens off the curve to the predicted level based on the area ratio.

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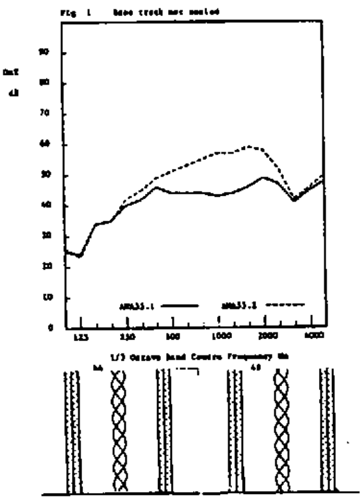

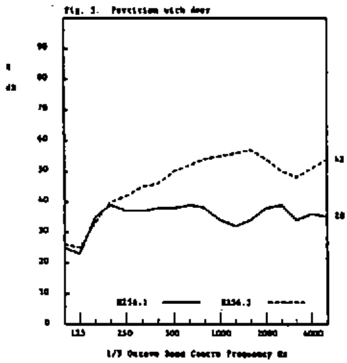

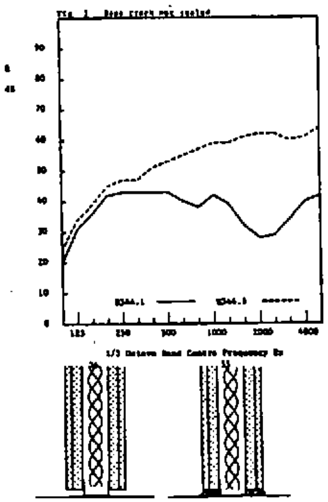

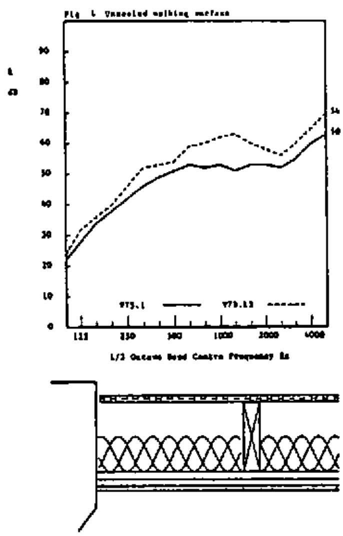

Fig. 5 Base partly sealed

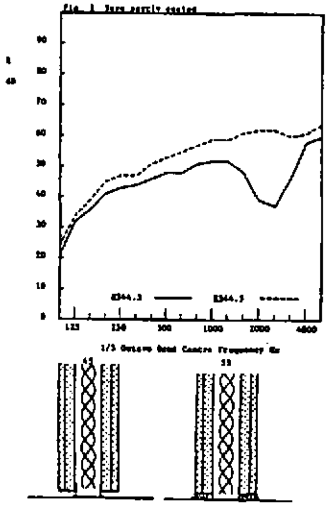

Fig. 7 Base not sealed - effect of skirting

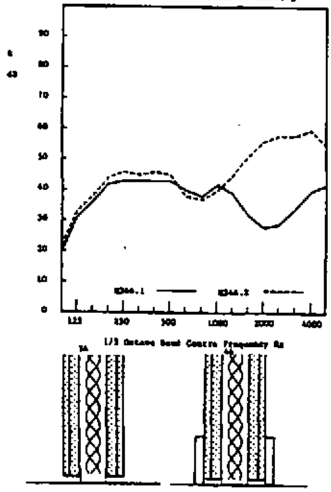

Fig 6 Studs with butted screw holes

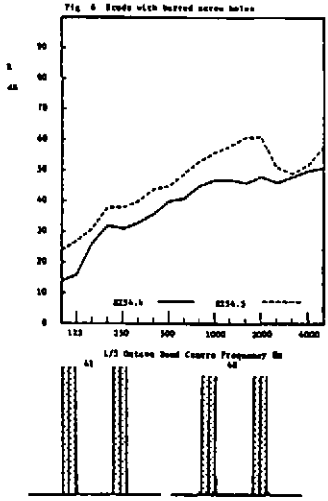

Fig 8 Base partly sealed - effect of skirting

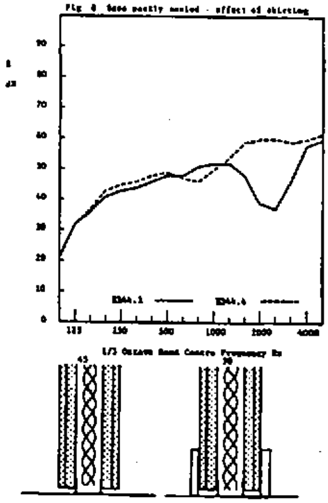

Fig 9. Electrical sockets

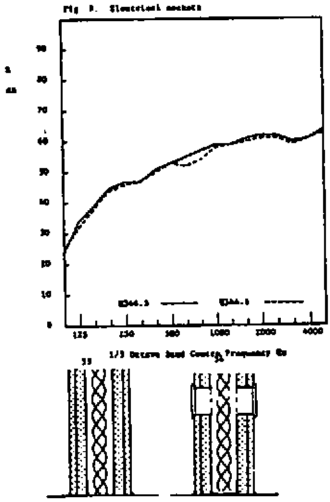

Fig 10. Electrical sockets

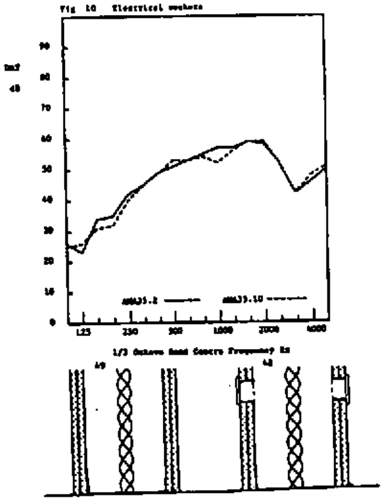

Fig 11. Electrical socket box holes

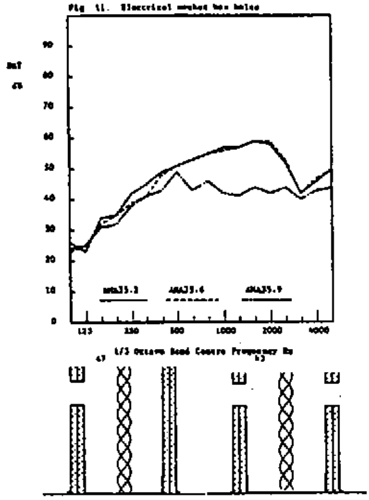

Fig. 12. 16 mm tube