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THE SOUND INSULATION OF PLASTERBOARD/MINERAL WOOL LAMINATES FIXED TO MASONRY WALLS

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INTRODUCTION

It has been well established that with careful design lightweight independent wall linings can substantially improve the sound insulation of a masonry wall at all frequencies. On the other hand, a simple plaster or dry lining finish will add little to the performance of the wall except to seal the surface should the masonry be porous. Unfortunately the former method of lining a wall is considered too expensive and space consuming for many applications and so an intermediate solution has been devised comprising a laminate of plasterboard and mineral wool. This is fixed directly to the wall using a gypsum based adhesive with the addition of a small number of spacer clips around each laminate to prevent excessive movement and thus cracking at the joints. At these points a nailable plug fixing is also made to ensure permanent mechanical integrity. This results in a semi isolated plasterboard lining which is coupled to the wall by both mineral wool and airsprings with a small amount of 'bridging' at the spacer points.

A series of laboratory and site tests have been carried out on such a laminate known as Tri-line and the work is described below.

BASIC CONSIDERATIONS

When attempting to quantify the benefits of dry lining applied to masonry backgrounds it is found that the type of substrate wall plays an all important part in both:

1) The improvements gained over the performance of the basic wall and

2) The absolute performance of the wall plus lining.

For example, 32 mm Tri-line (12.5 mm plasterboard + 19 mm mineral wool) fixed each side of a lightweight aggregate block wall gives a weighted sound reduction index (R_w) improvement of 30 dB over the basic wall with a resultant R_w of 52 dB (Fig. 1). The same lining applied to a dense concrete cavity block wall shows an improvement of 12 dB with a resultant R_w of 58 dB being achieved (Fig. 2). The reason for this difference relates in the main to two things:

1) The mass spring mass resonance of the lining on the wall.

2) The performance of the unlined masonry wall which is based not only on its mass and stiffness but on its material porosity and construction type i.e. solid or cavity.

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By calculation, the mass/air/mass resonance of 32 mm Tri-line on a heavy wall (200 kg/m^2 or more) falls within the 100 Hz 1/3 octave band. However, experimentation on the dense concrete block wall shows no resonance in this region but a resonance in the 63 Hz band (Fig. 3) whilst tests on the lightweight aggregate block wall indicate no substantial resonances down to 50 Hz (Fig. 3). This can be explained on the basis that the wall porosity produces an effectively larger cavity than anticipated. The basic walls can clearly be seen to exhibit porosity by comparison between tests on the bare wall and the wall sealed with lightweight plaster (Figs. 4 and 5). By comparison, 32 mm Tri-line fixed each side of a plastered block wall exhibits a resonance in the 100 Hz 1/3 octave band (Fig. 3).

Thus, in order to evaluate the lining, it is necessary to relate to the type of substrate wall which means that an extensive range of tests are necessary.

APPLICATIONS OF THE LINING

In designing experiments to evaluate the lining method it is useful to consider its applications and how measured data can be used to indicate its potential. Some possibilities are as follows:

1) New separating wall installations.
Table 1 lists field test information which is at present available for Tri-line fixed to lightweight aggregate solid and cavity block walls and dense concrete cavity block walls.

Table 2 lists laboratory test results on constructions lined with Tri-line which have an R_w equal to or better than that of a plastered dense concrete cavity block wall (mass in excess of 400 kg/m^2) which is known to produce adequate performance on site.

2) Remedial treatment.
Table 3 shows the improvements gained when 40 mm and 32 mm Tri-line are applied to a plastered lightweight aggregate solid block wall

The results show that a lining of 32 mm Tri-line fixed to one side of the wall results in a higher R_w than for the lining fixed both sides. This is caused by the resonance in the 100 Hz 1/3 octave band being magnified by the double lining. However, it can be seen that improvement occurs in the middle and high frequency range which will be useful in many situations (Fig. 6). 40 mm Tri-line performs marginally better at low frequency hence the higher R_w. In separating wall situations it would seem likely that a 40 mm or thicker product applied to one side of the wall is most applicable to ensure a good increase in single figure rating.

3) Flanking Transmission.
It is well known that a continuous leaf of masonry which runs across the end of a separating element can provide a medium for flanking transmission. The magnitude of the flanking transmission can be sufficient to cause failure to meet Building Regulations requirements even though the basic separating element is adequate. A typical example is in the use of timber joist or lightweight concrete floors between flats having walls constructed of cavity

block or brick. In this situation, the application of plasterboard/mineral wool laminates to the external and separating walls is likely to result in sound insulation improvements. It should also be noted that the thermal insulation properties of the lining will be applicable to meeting the requirements of the Building Regulations in this respect.

Comparison between the use of Tri-line and a conventional lining (eg. plaster) on various masonry substrates indicates the potential for improvement. The actual magnitude of improvement remains to be seen when site tests become available.

CONCLUSIONS

It has been seen that the plasterboard/mineral wool laminate can be used to advantage in lieu of conventional linings to upgrade the performance of masonry walls

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TABLE 1 - Field Test Information on Tri-line Laminates

Construction	Wall Mass kg/m^2	Weighted Standardized Level Difference (D_{nTw})
225 mm lightweight aggregate block wall with 10 mm sand/cement render one side. 40 mm Tri-line both sides	330	53, 55
Two leaves 100 mm lightweight aggregate blocks with 75 mm cavity. 32 mm Tri-line both sides.	276	52, 53, 54, 55
Two leaves 100 mm lightweight aggregate blocks with 50 mm cavity. 40 mm Tri-line both sides. 1 m vertical step in wall.	250	57, 62
Two leaves 100 mm dense concrete blocks with 13 mm sand/cement render both sides. 40 mm Tri-line one side 12.5 mm plasterboard other side.	465	57

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TABLE 2 - Laboratory Test Information on Separating Walls

Construction	Weighted Sound Reduction Index (R_w)
1) Two leaves of 100 mm dense concrete blocks (1950 kg/m^3) with 50 mm cavity.	
(a) **Plastered each side with 13 mm Carlite**	**52**
(b) Lined one side with 40 mm Tri-line	57
(c) Lined both sides with 32 mm Tri-line	58
(d) Lined both sides with 40 mm Tri-line	60
2) Two leaves of 100 mm lightweight aggregate blocks (1216 kg/m^3) with 50 mm cavity lined both sides with 40 mm Tri-line	54
3) 215 mm lightweight aggregate blockwall (1150 kg/m^3)	
(a) Lined both sides with 32 mm Tri-line	52
(b) Lined both sides with 40 mm Tri-line	53

TABLE 3 - Laboratory Test Information on Improvements to a Plastered Lightweight Aggregate Solid Block Wall (R_w = 51)

Lining	R_w	R_w Improvement over Plastered Wall
40 mm Tri-line one side	56	+ 5 dB
32 mm Tri-line one side	54	+ 3 dB
32 mm Tri-line both sides	52	+ 1 dB

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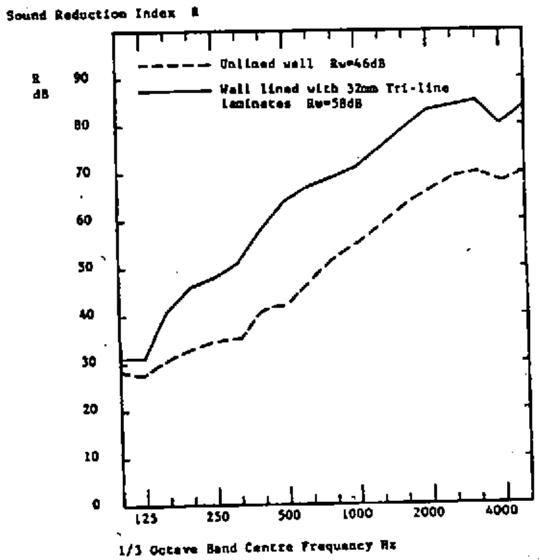

FIGURE 1.

Dense concrete cavity block wall unlined and lined each side with 32 mm Tri-line laminates.

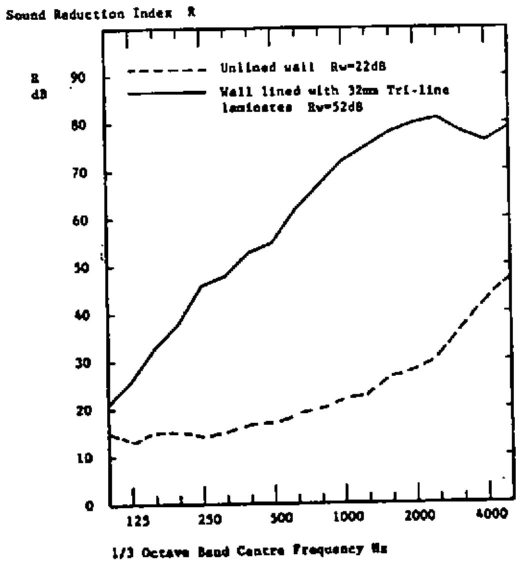

FIGURE 2.

Lightweight aggregate solid block wall (260 kg/m²) unlined and lined each side with 32 mm Tri-line laminates.

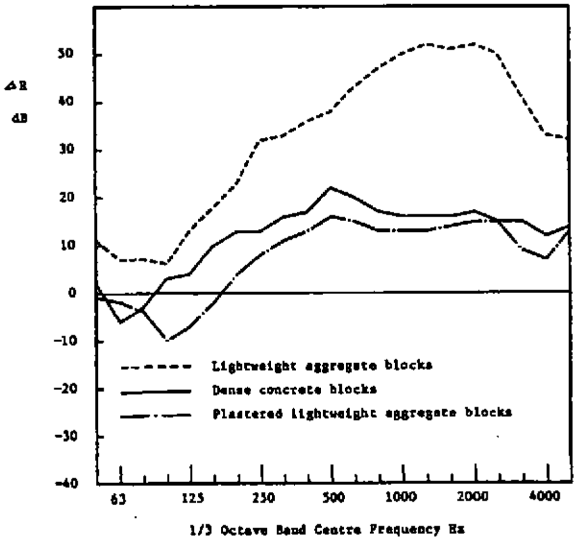

FIGURE 3.

The change in sound reduction index (ΔR) when 32 mm Tri-line laminates are fixed each side of three masonry walls.

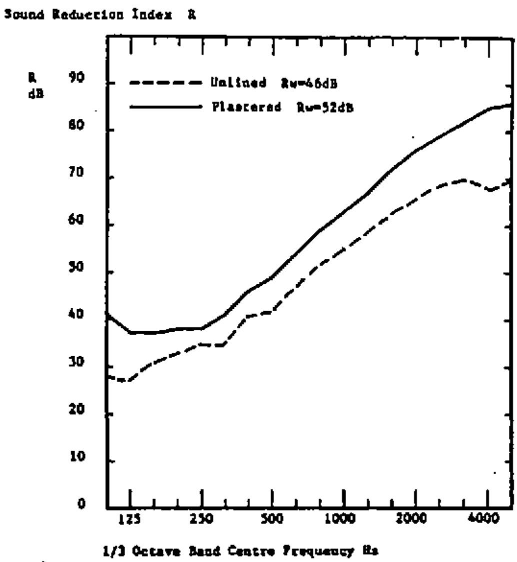

FIGURE 4.

Dense concrete cavity block wall unlined and plastered.

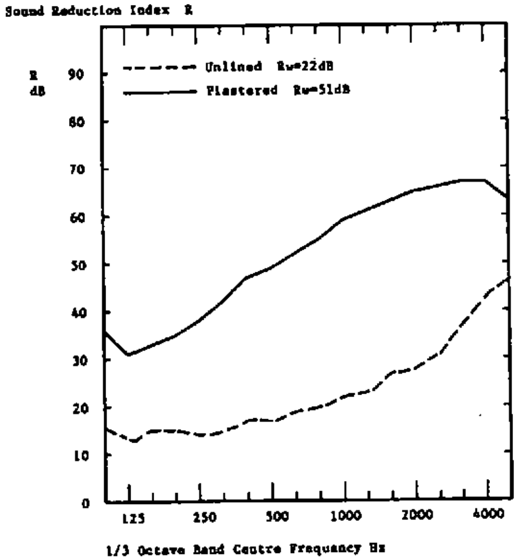

FIGURE 5.

Lightweight aggregate solid block wall unlined and plastered.

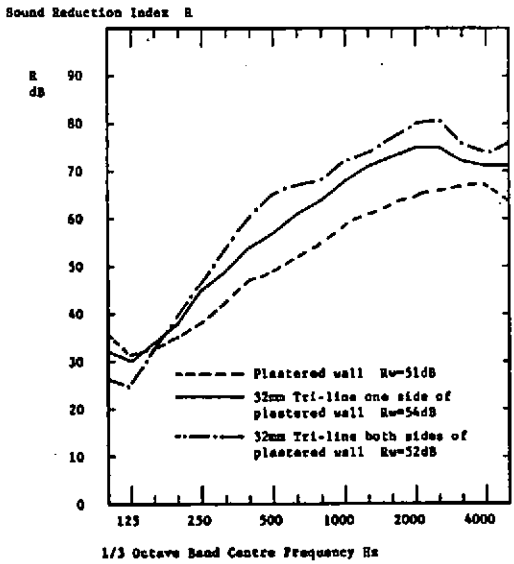

FIGURE 6.

Plastered lightweight aggregate block wall lined with Tri-line laminates.