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Sound insulation in office and domestic building

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Although the basic problems of sound insulation of walls, floors, windows, doors etc., are similar in both office building and in private housing the availability of money influences the approach to the solution at least in the two instances about which I want to talk.

In this particular case I am not concerned with office noise in the form of business machines and the general clatter of the typing pool but a situation which can arise in domestic building as well and that is of requiring high airborne and impact insulation between adjacent spaces, the sort of room which may be occupied by a Director and his Secretary and the corridor which passes his door. I am not dealing with a hypothetical situation but one which exists and where we have had the good fortune to accompany the performance of our experimental designs with the final construction.

It was necessary to provide executive office accommodation on one of the upper floors of a high rise building and yet because the steelwork had been erected before the sound insulation problems had been appreciated a high floor loading was not permissible and hence lightweight construction was essential.

A floating box principle was adopted. The experimental version of the offices consisted of two full size 'boxes' made with walls and ceiling of 2" woodwool cement slabs and prestressed concrete floor slabs which rested on neoprene. There was no mechanical contact between the walls or floors or between the office floors and corridor. Windows were provided which in the final building would form a double glazed system along with the windows of the curtain wall with a very large air space. The results of the experimental part of this work have been published elsewhere (1). However, the measurements obtained on the actual building have not and as much of the interest lies in what happens in passing from experiment to reality the results are summarised here in figure (1).
Figure 1 shows the sound insulation attained by the dividing wall between offices prior to the introduction of a door, then with the door. The figure also shows the effect of short-circuiting the resilient neoprene mounting proving that even the airborne sound insulation owes much to the mechanical isolation of the two offices.

Figure 2 is a summary of the measurements taken in the real office and shows a slight deterioration from the conditions in figure 1. This is almost certainly due to a change in the arrangement of the partitions so that they short-circuit to some extent the mechanical isolation provided by the neoprene. The airborne insulation is still quite high for a lightweight wall with a superficial weight around 12 lb/ft^2.

In domestic housing, and here I am really referring to modern terraced houses, very high insulation is only required between dwellings and modest insulation between inside and out and within the house. The latter, however, becomes more important as the house gets smaller and privacy for children doing homework becomes increasingly difficult to achieve. The 'floating box' principle although not impossible for domestic building appears at least in Britain to be too expensive and so more attention has to be paid to wall, floor, ceiling, door and window construction.

An experiment has been carried out on a real building site and modifications have been incorporated at the design stage with considerable improvement to the general acoustic environment of the house. In addition to the modifications listed in table I considerable attention was paid to the re-routing of the ducting to the warm air system so that walls were not simply short-circuited and an absorbent lining was introduced to reduce transmission along the duct. Double glazing was introduced to reduce the ingress of noise, silent ball valves and plastic piping were used wherever possible to reduce plumbing noises.

Figure 3 compares the insulation achieved between two adjacent bedrooms as an example.

The important point to notice here is that the solutions are not highly sophisticated, nor particularly expensive although some increase in cost is inevitable, but they are based on what might be called acoustic common sense. For instance, a single sheet of plasterboard 1" thick would have a coincidence plateau right in the range 100 to 3200 Hz because of its high bending stiffness whereas two pieces ½" thick only lightly bonded will have the same mass but a stiffness only slightly higher than a single ½" sheet.

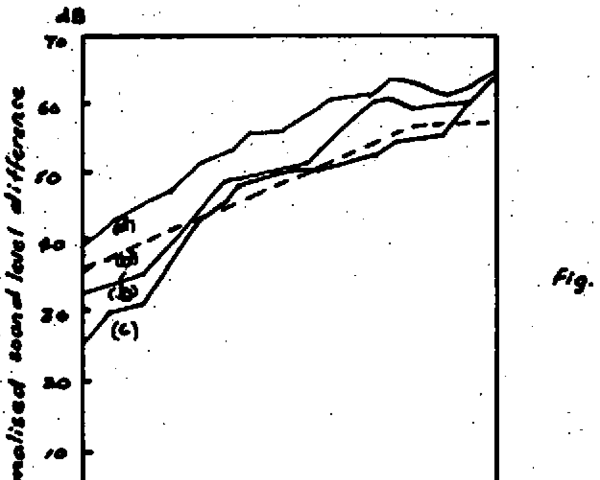

Fig. 1.

(a) with the doorways blocked up
(b) with the double door system fitted
(c) with wooden wedges by-passing the rubber mounts
(d) grade 1 (U.K.) curve for airborne sound insulation between dwellings

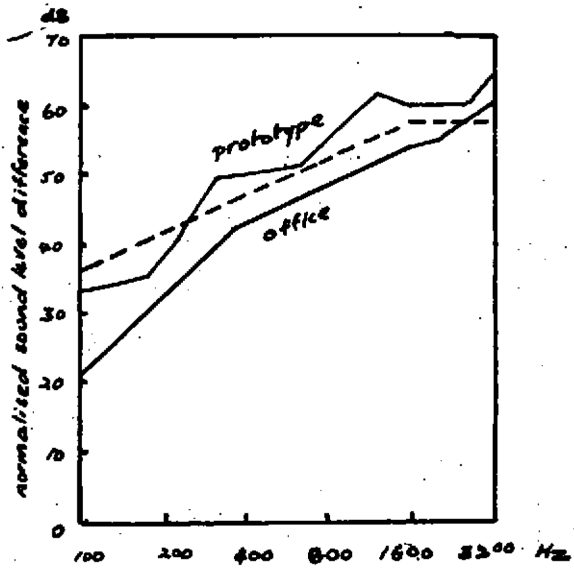
dB
70
60
50
40
30
20
10
0
100
200
400
800
1600
3200 Hz
normalised sound level difference
prototype
office

Fig 2.

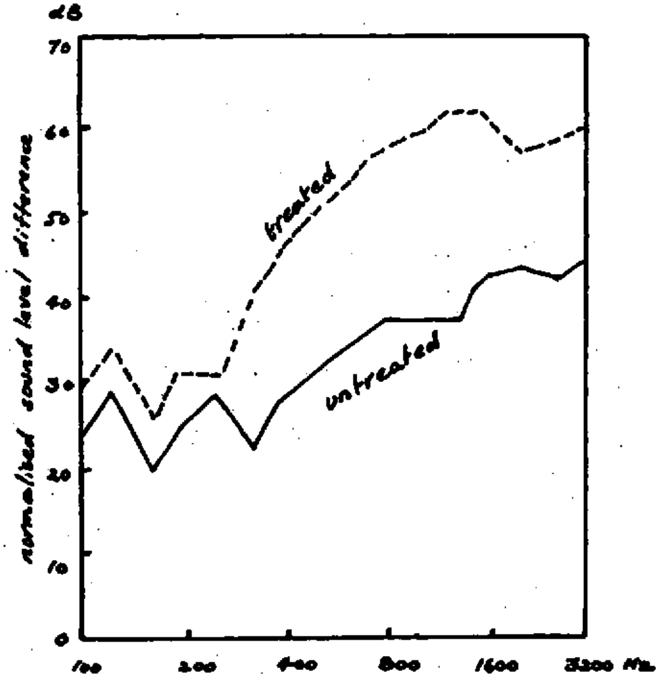
dB
70
60
50
40
30
20
10
0
100
200
400
800
1600
3200 Hz
normalised sound level difference
treated
untreated

Fig. 3

Component	Basic House	Modified House
External walls	Prefabricated storey height timber frame components 2"x4" CLS timber members at 16" centres clad externally with $\frac{3}{8}$" plywood, internally lined with plasterboard. $\frac{1}{8}$" skim coat finish.	as for basic
Internal walls	As for external walls but lined on both faces with $\frac{1}{2}$" plasterboard finished with $\frac{3}{8}$" skim coat.	For example - Bedroom 1/bedroom 3 further $\frac{1}{2}$" plasterboard on both sides Bedroom 1/landing further $\frac{1}{2}$" plasterboard on both sides
Ceilings	10" x 2" CLS joists spaced at 16" centres having $\frac{5}{8}$" plywood sheathing and lined to ceiling with $\frac{1}{2}$" plasterboard ARTEX finish.	2" mineral wool between joists above plasterboard. Extra $\frac{1}{2}$" plasterboard over dining and kitchen area only
Windows	Single glazing in 32 oz glass with sliding components	Double glazing in 32 oz glass with 4" spacing with sliding components
Doors	Hollow cored	Solid cored Phosphor Bronze sealing strip. Hardwood threshold and expanded soft rubber draft excluder. Rising hinges
Party wall	Twin storey height timber components spaced overall 1' 1$\frac{1}{2}$" each component containing mineral wool quilt between studs, both components lined on room side with 1$\frac{1}{4}$" ($\frac{3}{4}$" + $\frac{1}{2}$") finished with $\frac{1}{8}$" skim coat of plaster	Only modification replacement of ($\frac{3}{4}$" + $\frac{1}{2}$") plasterboard with ($\frac{1}{2}$" + $\frac{1}{2}$" + $\frac{1}{2}$").

Table I

Reference:

Offices with high sound insulation. R.D. Ford, P. Lord and A.W. Walker. J. Appl. Acoustics, p.21/28 Vol I No I.