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DATA ON THE FIELD MEASUREMENT OF SOUND INSULATION IN BROADCASTING STUDIO CENTRES

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INTRODUCTION

When designing new facilities, the BBC, in common with other designers in the broadcasting and recording industries, is particularly sensitive to the need to provide adequate sound insulation between various operational areas. Over the years many hundreds of acoustic partitions have been constructed, such as those between studios and control rooms, those between recording rooms and office accommodation, etc. Many of these partitions have been subjected to formal acoustic tests and the results of these tests, therefore, form a useful data base against which other partition designs can be compared. This paper describes the acquisition of this data and its compilation into an acoustic designer's handbook [1].

TEST PROCEDURE

The BBC's normal test procedure for the field measurements of airborne sound insulation between two rooms is illustrated in Fig. 1. A loudspeaker is positioned away from the partition under test in the source room such that the partition under test is exposed to a diffuse reverberant sound field. This normally means pointing the loudspeaker towards one of the opposite corners of the room. The resulting sound pressure level is measured at a number of microphone positions in front of the partition under test and throughout the volume of the receiving room on the other side of the partition. At one time these measurements used to be made with a conventional sound level meter, but more recently, a real-time third-octave spectrum analyser has been used. The average sound pressure level for each room is then computed and the difference between these two averages gives the sound level difference for that form of partition under those circumstances.

The normal signal source used for these tests is a frequency modulated tone, commonly called 'warble' tone. This has the distinct advantage over a random noise source of a much lower peak to mean power ratio and thus enables higher levels of sound insulation to be measured than would be possible using noise. On occasions the warble tone source has not been available and then random noise generators have had to be used in its place.

The only occasion where the technique changes significantly is when very high values of sound level difference are anticipated. Under these circumstances, a twin-channel Fast Fourier Transform Analyser is used together with a repetitive pseudo-random noise source. By synchronously averaging the source and receive signals it is possible to improve the signal-to-noise ratio by up to 30dB without imposing too great a time penalty on the duration of the test sequence.

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COLLATION OF RESULTS

In all, 380 results have been found with sufficiently complete documentation to be valid and useable in the handbook. These comprise a considerable number of different partition constructions, some of which have been used frequently. For the latter categories the results are grouped according to construction type and thus average insulation values and standard deviations for the group can be computed. Where too few examples exist for such averaging, the results are grouped according to overall performance of each partition in bands of 5dB. Thus there are additional groups from 50/55dB to 75/80dB together with a final group for partitions giving an average insulation in excess of 80dB.

Each classification comprises a description of the group as a whole; the form of construction, details relating to doors and windows etc. Any specific differences between individual samples are also listed. The individual results for each partition are tabulated as a spectral response in 1/3 octave bands from 50Hz to 8kHz. An average performance figure for each partition is also given, together with an overall average spectrum for the group as a whole.

The average performance figure is a linear average centred on 500Hz. Normally this will cover the band 100Hz to 2.5kHz but if, because of signal-to-noise ratio problems, some of the upper frequency results are not available, then symmetrically disposed low frequency results are also excluded from the average. More recently other overall rating figures have been introduced, such as Sound Transmission Class (STC) or Noise Isolation Class (NIC), but historically the BBC has found the 500Hz average to be the most useful single figure number for the types of partition it constructs.

Finally, for each group, the results are presented in a graphical form. presented in a graphical form. Where large numbers of samples exist, graphs are presented of a) mean result and standard deviation and b) mean result, best result and worse result. Where too few examples are available for the averages to be meaningful, the individual results are plotted in groups of up to five at a time.

Altogether the 380 samples are grouped into 38 form-of-construction classifications and 8 performance groups. The 38 form-of-construction groups are further collated into lightweight partitions, masonry partitions, outside broadcasting vehicle walls and miscellaneous (e.g. doors, demountable enclosures etc.)

SOME EXAMPLES OF THE SURVEY RESULTS

One useful collation of partition results is that relating to double and triple masonry walls. Not only does it show, in the context of this paper, the form of data presentation, but the contributions of various elements to the insulation performance are clearly illustrated within this group.

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Fig. 2 shows the results for a group of double 112mm brick partitions with 50mm cavities. The partitions also include triple-glazed observation windows and double personnel doors via an acoustically treated sound lobby. Overall the mean insulation is 54.0 ± 5.5dB. However, further appraisal of this group indicates that whilst some of the group were built with solid metal wall ties, others were built using flexible wall ties. Subdivision of the group into these two categories shows that the cavity walls with solid wall ties give an average performance of 50.7 ± 3.8dB whilst those with flexible wall ties give an average performance of 56.3 ± 4.7dB. A further category without the observation windows and personnel doors but otherwise identical to the above gives an average performance of 59.1 ± 7.5dB.

Several forms of triple partition are also given in the handbook, of which the results for two are illustrated here. In both cases the partition uses three 150mm thick leaves with 50mm cavities, the outer leaves being of blockwork whilst the centre leaf is of concrete (a load bearing wall). In addition, the outer leaves are floated on separate floor rafts in the two adjoining rooms. The floor rafts are of lightweight concrete screed, floating on a blanket of mineral wool. In Fig. 3, the results are shown for partitions between studios and their own control rooms, which of necessity include triple glazed windows and double doors via a sound lobby. In this case, the sound insulation is 62.1 ± 2.5dB. In contrast Fig. 4 shows the results for partitions between studios and control rooms other than their own, which, therefore, have no need for direct physical or optical connection. Hence the partition is pierced by neither door nor window. In this case, the performance is improved to 84.4 ± 3.3dB. The need for reasonable access is clearly limiting the overall performance of the triple partition.

CONCLUSIONS

A full survey of the BBC's sound insulation field test results over a span of 15 years has identified a large number with sufficiently complete documentation to form a useful data base for an acoustic designer. This data base has been reproduced in the form of a handbook [1].

ACKNOWLEDGEMENTS

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REFERENCES

[1] D.J. Meares, K.E. Randall and K.A. Rose, 'Sound Insulation of Partitions in Broadcasting Studio Centres: field measurement data', BBC Engineering Publication, September, 1986.

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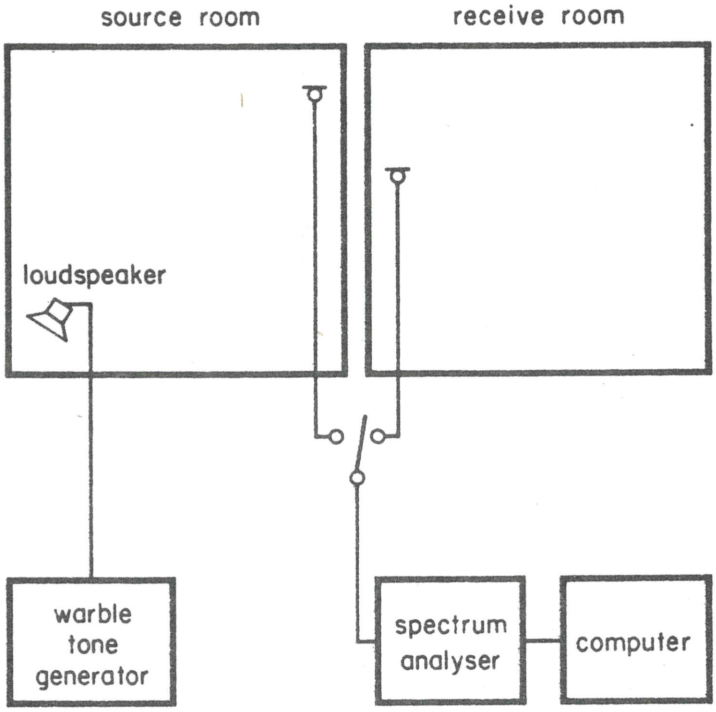

Fig 1 Test Proceedure.

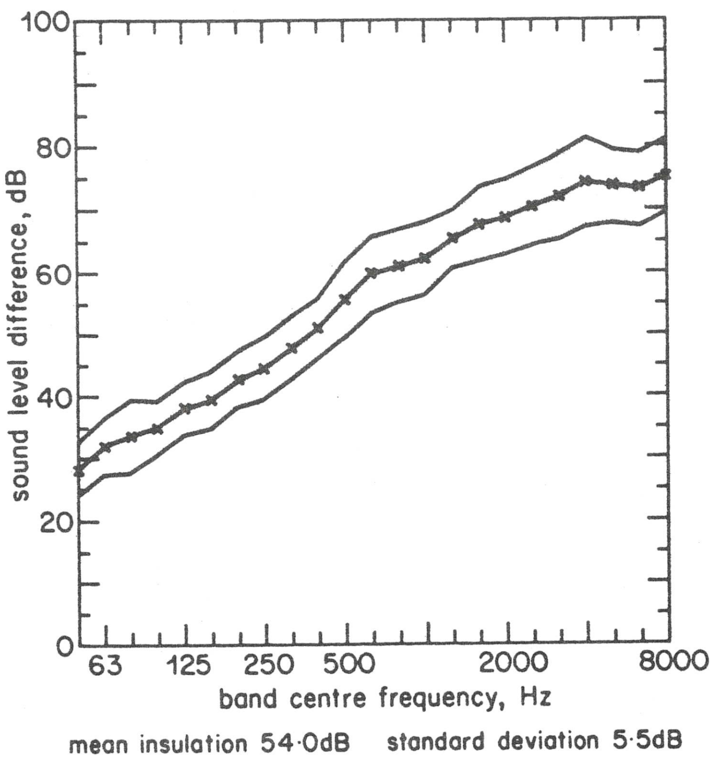

Fig 2 Sound insulation of double 112mm brick partitions with 50mm cavities (with triple glazed windows and doors via a lobby).

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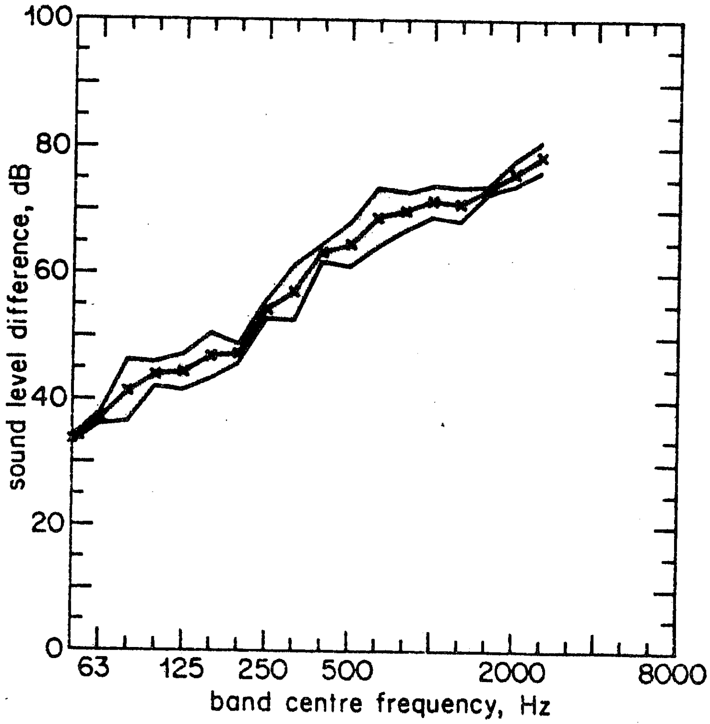
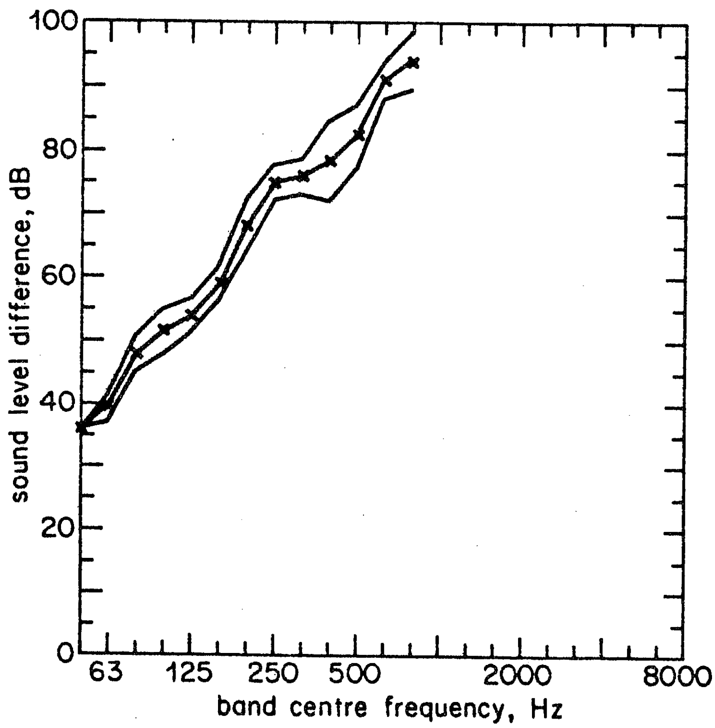


mean insulation 62·1dB standard deviation 2·5dB

Fig 3 Sound insulation of triple 150 mm masonary partitions (with double glazed windows and doors via a lobby).



mean insulation 84·4dB standard deviation 3·3dB

Fig 4 Sound insulation of triple 150mm masonary partitions (with no doors or windows).