# THE MEASUREMENT OF STRUCTURAL DAMPING

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## INTRODUCTION

The damping or total loss factor of a building structure is a very important parameter for building acoustics. For virtually all walls except lightweight plasterboard walls, the frequency region of interest is above the critical frequency and sound transmission is dependant on the structural damping. For all aspects of sound transmission a change in the total loss factor of 1dB causes a 1dB change in the transmission loss and so it can be seen that this is a very important parameter.

Despite the importance of the parameter it is a material property about which little is known that is of practical use. Figures given in standard texts are the internal loss factor. This is only a very small part of the total damping and for walls and floors the dominant source of damping is in transmission of the energy from the wall of interest to another part of the building.

## IMPULSE METHOD

One method of determining the total loss factor of a wall is to measure it, but conventional techniques that can be applied in the laboratory are not suitable for use under field conditions. Measurement of the bandwidth of modes requires a large shaker to excite the wall and is unsuitable due to the weight of the shaker (typically 100Kg) and because of the difficulty of attaching the shaker to the wall without damage. Other techniques such as interupting a steady state noise source and measuring the structural reverberation time have the same problems of requiring a large shaker as a source.

An alternative technique is to use an impulsive source to measure the reverberation time and is analgous to using a gun to provide an impulsive source for the measurement of the reverberation time in rooms. A suitable source is a rubber headed hammer such as is used by sheet metal workers. This hammer will provide a portable source which can be used to excite almost all walls or floors. The rubber head protects the wall surface so that it can be used in decorated buildings provided the plaster is not too soft. The rubber head also ensures that the hammer bounces clear of the wall to give a "clean" impact.

The most suitable method of measuring the reverberation time is to record the signal from an accelerometer mounted on the wall onto a tape recorder so that analysis can be carried out at a more convenient time. This reduces the site time and also the equipment necessary on site.

In the laboratory analysis of the decay curves can be carried out in the same way as for gun shots in rooms except that as the reverberation times are much shorter, some changes must be made. Typical values for the reverberation time are from 220 msec to 40 msec,(corresponding to 100Hz and 3150Hz respectively).

These are very short and a conventional graphic level recorder is too slow. Several methods can be used to obtain the reverberation time depending on the instruments that are available. One of the easiest methods is to record the impulse from the tape recorder onto a digital event recorder. From this the pulse can be replayed as often as desired by the push of a button for frequency analysis and for the adjustment of control settings. The replay can also be slowed down to a slower speed to suit the other instruments. For the measurements that were made the signal was fed from the digital recorder to the measuring amplifier where it was filtered and converted to a lograthmic DC signal. The output was then fed to a storage oscilloscope where the trace was analysed as shown in fig. 1.

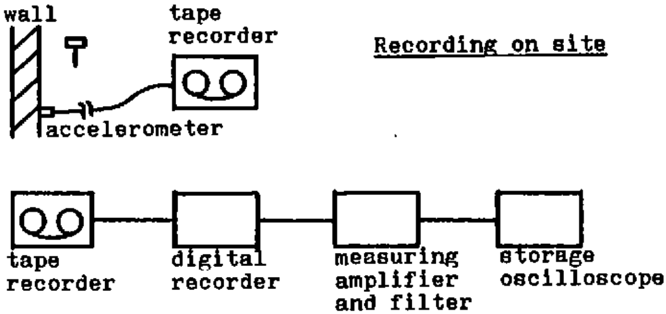


Fig 1 Instrumentation for the measurement of structural total loss factor.

## RESULTS

The largest single source of error in the measurement of the damping is in the interpretation of the decay curves to give the best fitting straight line. The curves are generally less clear than corresponding curves for gun shots in rooms and errors of about $\pm$ 2dB will occur due to interpretation of the best fitting straight line. This can be seen in fig. 2 which shows the measured average total loss factor of a wall measured three different times, from the same original recording, by different operators over a period of a year.

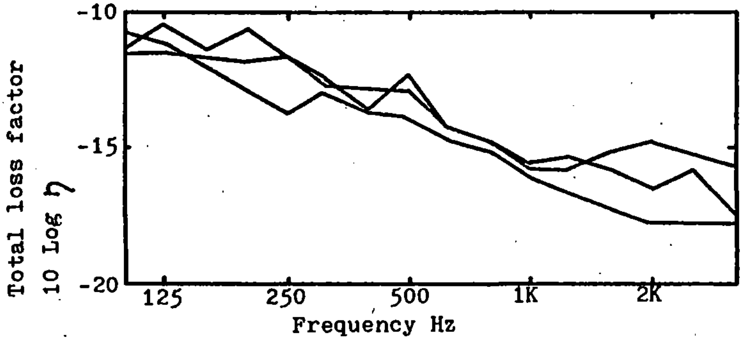


Fig 2 Total loss factor of a wall measured by different operators at different times.

Other sources of error tend to be small compared to this error which places a limit on the accuracy of the technique. So far no automatic system has been found that can produce even this degree of accuracy so that analysis of the decay curves has to be carried out manually.

The results of measurements made on a large variety of walls and floors show that reliable and consistent results are obtained (1). Similar walls and floors give similar results and as these results can be accuratley predicted, this gives further indirect proof that the correct material property is being measured.

## CONCLUSION

The results show that by the use of an impulsive source a very simple technique can be used to measure an important parameter necessary for all aspects of sound transmission through buildings.

## REFERENCES

1) Craik, R.J.M. and Wong, L.J. The measurement of material properties in buildings. Paper 1.16. Proceedings of the Institute of Acoustics. Spring Conference. 1980