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SHORT TEST METHODS FOR THE MEASUREMENT OF SOUND ISOLATION IN BUILDINGS

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The demands in both equipment and time of standardised methods of measuring sound isolation in the field make the development of a simplified method, using a minimum of inexpensive equipment, a desirable aim. The method may be considered as a screening process to determine borderline constructions, which could then be investigated in more detail, or as a method giving results which correlate with subjective satisfaction. If intended as a screening method it should give results which relate to an airborne sound insulation index, although the numerical values need not be identical. If it is to be a method which investigates subjective satisfaction it need not necessarily be related to a sound insulation index, but to some other numerical quantity which might correlate more closely with satisfaction.

Methods which have been suggested as an alternative to standard procedures (ISO/R140/R717) include:

a) impulse noise (1, 2, 3)
b) octave band measurements over the range 125 Hz to 4,000 Hz (4, 5)
c) restricted range octave band measurements (6)
d) wide band noise measurements (6-19)
e) measurements using specially designed equipment to give the read-out (1, 2, 11, 12, 13, 14)

There are also other procedures which give a simplification of the measurements in terms of the duration of the field measurements but require expensive equipment in the laboratory, e.g. computers to analyse field tape recordings.

The variations between the different measurement procedures are:

1. In the source room, (a) the source type and characteristics, (b) the measurement positions, (c) the measurement frequency weighting.

2. In the receiving room, (a) the measurement positions, (b) the measurement frequency weighting, (c) normalization for the room characteristics, (d) processing of the measurements.

The Source Room

Impulse measurements have often employed a pistol shot but tone pulses have also been used. However, the most favoured source characteristic is a pink noise in order to give a level spectrum when measured on an octave or $\frac{1}{3}$-octave basis. A spectrum approximating to pink noise is more readily obtainable in the room than genuine pink noise because of the radiation characteristics of loudspeakers and the room effect. For example the proposed ASTM method gives a range within which the source room spectrum should lie. This range is 3 dB wide above 125 Hz but widens to 20 dB at 63 Hz.

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Source Room Measurement Positions

There are a number of suggestions for measurement positions. For example, five uniformly arranged positions chosen so that the microphone is between 1.2 and 1.5 metres above floor level and not close to other room surfaces. A wide band source gives improved uniformity of sound field and fewer positions are necessary.

Measurement Frequency Weightings

Wide band methods include combinations of A and C weightings. In general, C weighting measurements in the source room may be preferred on technical grounds, but A weighting is sometimes recommended for simplicity.

The Receiving Room Measurement Positions and Frequency Weightings

These are similar to recommendations for the source room but there can be special difficulties in averaging at low frequencies, due to their emphasis in the receiving room by the building transmission characteristics. This may cause inaccuracies in methods which rely on a small number of positions, although dBA weighting will decrease the importance of the low frequencies. Frequency weightings are also similar to those in the source room except that A weighting is favoured instead of C weighting.

Normalization

General problems of normalization of measurements have been considered and the following conclusions drawn:

a) Normalization in terms of 10 log $^{S}/_{A}$ is relevant only to flanking-free laboratory measurements.

b) Normalization in terms of 10 log $^{T}/_{0.5}$ is applicable to any pair of rooms, even without common boundaries.

c) Normalization in terms of 10 log $^{A_o}/_{A}$ is complicated by the fact that, for realism, the standard absorption should be a function of floor area.

Some simplified methods recommend measurements of the sound level close to the source and in the reverberent field in the receiving room to give the normalization correction. These methods require that a calibration constant for the source is known. The proposed ASTM method defines a specially shaped spectrum which falls off at about 6 dB/octave between 125 and 500 Hz and 10 dB/octave at higher frequencies.

CONCLUSIONS

Simplified methods of measurement of sound isolation using a wide band sound source appear to be capable of giving reliable and consistent results and there is a recent ASTM Tentative Recommended Practice for a method (18). Most of the basic aspects have already been explored in the development of the ASTM method

but the following may merit continued investigation.

a) The sensitivity of the assessment to the spectrum shape in the source room.

b) The relation between spread of the readings in the sampling region, the number of readings taken and the accuracy of the measurements.

c) The relative merits of A or C weighting in the source room.

d) The relative merits of normalization by reverberation time and by absorption and how the appropriate quantites might be measured.

e) The effect on the measurement of direction of propagation between unequal rooms.

f) Subjective reaction to intruding noise.

g) The difference between rooms in different countries in so far as these might affect attempts at international standardisation.

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