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A SUBJECTIVE STUDY OF PARTY WALL SOUND INSULATION

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THE SURVEY

Standard procedures for measuring the transmission loss of party walls have existed for many years. However, little effort has been directed to comprehensive field studies attempting to relate adverse subjective responses to acoustical measures of sound insulation. The present paper summarizes the results of a limited study consisting of interviews of 98 subjects and acoustical measurements of their 49 common walls [1].

Potential subjects were first sent an introductory letter; those who agreed were questioned by a trained interviewer in their homes. The responses to most questions were in the form of seven-point Likert-type scales. After each successful interview, permission was requested to make acoustical measurements at a later date. These measurements included the A-weighted background noise levels for one 24-hour period in each subject's living room, and the sound transmission loss (TL) of each party wall in 1/3 octave bands from 100 to 4000 Hz. The sound transmission class (STC), the noise isolation class (NIC), A-weighted level difference and TL type measures, as well as the British Aggregate Adverse Deviation (AAD), were calculated. Statistical analyses were carried out using the Statistical Package for Social Sciences.

RELATIONS BETWEEN ACOUSTICAL MEASURES AND SUBJECTIVE RESPONSES

Some response measures were significantly correlated with acoustical measures of sound insulation, some were correlated with the L_{eq}^{24} measured in the neighbour's home, and some were related to both types of acoustical measures, as shown for a few responses in Table 1. The magnitude of the correlation coefficients for the three TL measures (STA, AAD and STC - incorporating corrections for the party wall area [S] and measured receiving room absorption [A]) were quite similar.

The simple noise level difference measures (DA - the difference in A-weighted levels) and NIC produced slightly lower correlations than the corresponding TL-type measures (STA and STC). This suggested that it was peak levels and not reverberant field levels that led to annoyance. The multiple correlation coefficients between the responses and combinations of STC and $L_{eq}{}^{24}$ were generally a little larger than the simple correlations. Multiple correlations with combinations of $L_{eq}{}^{24}$ and STA or AAD produced similar results.

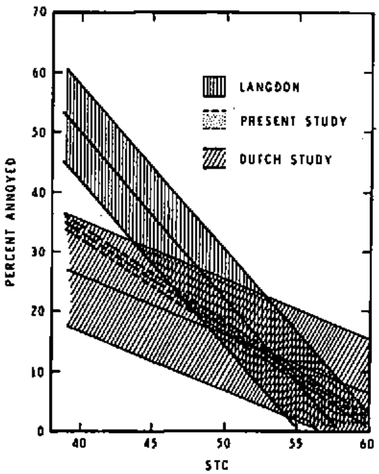

Fig. 1. Mean ± standard deviation of percentage annoyed versus STC for three studies.

Figure 1 compares the percentage of annoyed subjects as a function of wall STC from the present study and recent British [2] and Dutch [3] research. The differences between the three studies were at least partly due to the necessary approximate conversions between sound insulation measures. Better agreement with Langdon's data was obtained by calculating AAD's for the present results as shown in Fig. 2. The three studies thus produced similar results.

The cost of inferior sound insulation is suggested by the reported number of dollars per month that subjects were willing to pay to improve sound isolation; this correlated quite strongly with measures of the party wall sound insulation. The mean response decreased to approximately zero for an STC of 60, suggesting that this was ideal. Multiple regression analyses indicated the influence of several non-acoustical variables. Annoyance was found to increase with increasing values of: length of residence, value of the home, daytime periods at home, and a psychological stress scale. Decreased annoyance was associated with increased feelings of: neighbours being considerate, building officials being helpful, and satisfaction with their building. However, there was evidence that the inadequacy of party walls was sometimes unfairly blamed on inconsiderate neighbours. Education, income, age, and sex were generally insignificant predictors.

DERIVATION OF AN IDEAL WALL

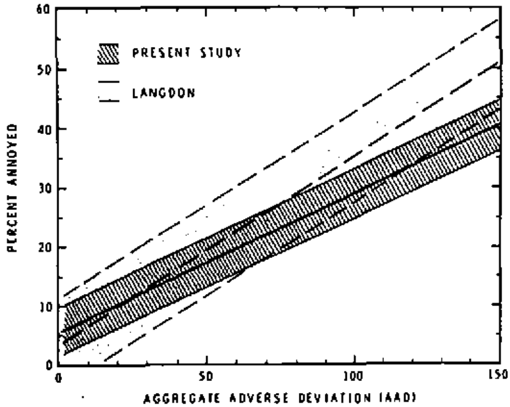

Fig. 2. Mean ± standard deviation of percentage annoyed versus AAD for two studies.

Correlations between 1/3 octave TL values and the dollars-per-month response, shown in Fig. 3, were highest in the range 160 to 400 Hz. Similar correlations with responses were generally only significant in the 100 to 1000 Hz region. Apparently subjects only hear their neighbours in this frequency range; for higher frequencies, the mean measured TL was more than adequate. Thus, at 1250 Hz, a TL of 60 dB was considered ideal. For higher frequencies, a conservative estimate was that 60 dB TL would suffice in all bands. This was higher than the mean measured results. The TL characteristics of an ideal wall at lower frequencies were derived by first assuming that the 10 phon contour represented the threshold of detectability in the receiving room, due to the fluctuating nature of background noises. The source room level at 1250 Hz was calculated from the sum of the 10 phon threshold, the required 60 dB TL and an average 10 log S/A correction of 3 dB. Assuming a pink spectrum from 100 to 1250 Hz to be typical of music and other domestic noises, the mean maximum source room levels would be 73 dB in each of these bands. From the differences between this source spectrum and the receiving room threshold of detectability, ideal TL values were calculated and are plotted in Fig. 4. If the source spectrum had been assumed to decrease at 6 dB/octave above 1600 Hz, the plotted points would have resulted; they are very close to the initial assumption of a 60 dB TL plateau. The ideal wall has an STC of 59, which is similar to the optimum of STC 60 derived from the dollars/month response. Should more complete studies produce similar results, the STC contour could be modified to extend 1 band lower and have a 3 dB lower high frequency plateau, as illustrated in Fig. 4.

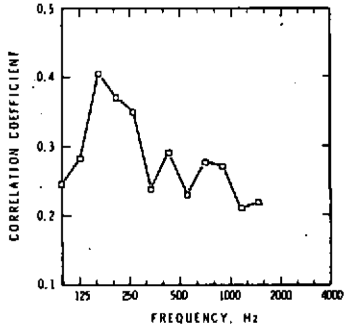

Fig. 3. Correlations between dollars/month response and 1/3 octave transmission loss values.

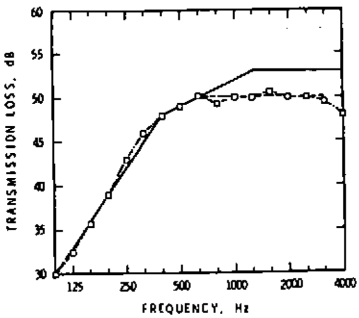

Fig. 4. Transmission loss characteristic of ideal wall (□), STC contour (—), modified STC contour (---).

Table 1: Correlations between responses and acoustical measures

Annoyance Response	DA	STA	AAD	NIC	STC	L_{eq}^{24}	$STC+L_{eq}^{24}$
Neighbours', Voices	-.168	-.218	.220	(ns)*	-.210	.213	.316
Neighbours' Music	-.189	-.217	.212	-.196	-.196	(ns)	.246
Neighbours' Children	(ns)	(ns)	(ns)	(ns)	(ns)	.331	.333
Overall	-.201	-.245	.252	-.200	-.222	.245	.350
Dollars/Month	-.360	-.378	.396	-.339	-.355	(ns)	.355

* (ns) = not significant.

REFERENCES

[1] J.S. Bradley, Subjective Rating of the Sound Insulation of Party Walls, BRN 196, National Research Council Canada, Ottawa, October 1982.

[2] F. Langdon, "Noise from Neighbours and Sound Insulation of Party Walls in Houses", Journal of Sound and Vibration, 79, (2), pp. 205-228 (1981).

[3] F. de Roo, G.L. Bakker, and J.A. Atzema, "Geluidisolatie Tussen Eengezinhuizen en de Beleving von Buurgeluiden", Rapport nr. 6077/1981, Boucentrum, Rotterdam, 1981.