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NOISE FROM NEIGHBOURS AND THE SOUND INSULATION OF PARTY WALLS

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BUILDING RESEARCH ESTABLISHMENT

1 INTRODUCTION

It is now some twenty five years since the studies, on which present building regulations governing the sound insulation of party walls and floors are based, were carried out by Building Research Station(1). This lapse of time, together with the recently reported results on the incidence of neighbours noise(2), studies of measured sound insulation(3), and the degree of conformity with the regulations(4) has made pertinent a fresh attempt to relate the experience of dwelling occupants over a range of measured insulation values and this paper represents a brief summary of results so far obtained of work in progress.

The national survey of the incidence of nuisance occasioned by neighbours noise(2) was of necessity conducted without the benefit of physical measurements, while the review of standards achieved in practice(4) included no information derived from present occupants, being based on measurements made over many years at completion of the buildings. Nevertheless, this collection of some 1270 sound insulation measurements provides the base on which may be constructed a sample of dwellings, the occupants of which could be interviewed. It will be understood that such a sample is not necessarily a representative incidence, nor a stratified equi-probability one, but merely the product of whatever data are available. But by dint of careful study of this data a viable sample was constructed. The main considerations governing this operation and the methods employed for the survey will now be briefly outlined.

2 SURVEY METHOD

The data base comprised airborne and impact sound measurements of party walls and floors in houses and flats. It was decided to confine the study initially to houses and postpone the more difficult problems of flats, though the latter are now in process of survey as well. There were 903 airborne sound measurements in semi-detached and terrace houses. Not all could be used however, for reasons which will become apparent. The sets of measurements used yielded 160 dwellings distributed over the range of AAD dB as in Table 1.

AAD dB	0-23	24-47	48-71	72-95	> 95
No	91	33	23	9	4

There were clearly many 'good' and few 'poor' cases. But as the actual sample of dwellings had excluded all cases in which analogous structures were likely to depart from the measured values by more than $\pm$ 15 AAD, the survey sample was restructured by adding analogue, unmeasured dwellings to swell the deficient categories. This produced the actual sample shown in Table 2.

AAD dB	0-23	24-47	48-71	72-95	> 95	Total
No	282	241	216	95	83	917
%	30.5	26.0	23.5	10.5	9.5	100

The table shows the sample interviewed. Actually 1248 dwellings were selected, of which 234 were lost through absence of occupants, etc, and a further 97 by refusals of interview. Thus 74% of the original, and 90% of the effective sample was interviewed. When a 'measured' sample is employed, 'quota' replacements cannot be used. The greatest effort had therefore to be made to secure each interview and this was in the main achieved.

The questionnaire, consisting of 78 items, was divided into seven sections for neighbourhood quality rating, house quality rating, external noise, noise from neighbours, noise within the dwelling, sound insulation rating, and respondent classification, to take account of all factors which might bear on occupants' experience. 'Classification' embraces occupational class, household income, rent, tenure and type of dwelling, and noise sensitivity. Ratings of noise, environmental and house quality were assessed by open-ended or by tested multipoint scale questions. The data were submitted to principal component, correlational and multiple regression analysis.

3 RESULTS

The data obtained from the survey are very extensive and analysis is still proceeding. Only a small selection of present findings can therefore be given here. Overall, 68% of the sample hear some noise from neighbours, though only a proportion are bothered by this. In fact, over three quarters of the sample find it quite acceptable to hear some noise, while considering the most commonly reported noises, only 18% of the sample (27% of those hearing noises) are bothered 'quite a lot' or 'very much'. This does not mean however, that neighbours noise can be ignored, for 55% of the sample, or 81% of those hearing noise, say they must be careful not to make too much noise themselves. Again, 36% of occupants rated the sound insulation of their homes as poor or very poor, and an even higher proportion, 43% judged it as falling below or well below their expectations.

Looking at the same data broken down according to measured values of insulation, a fairly clear pattern of relationships is apparent. In Table 3 is shown the proportion hearing neighbours noise, the degree of annoyance from the most bothersome noises, rating of insulation, and the level of expectation of insulation over the measured range grouped at 24 AAD intervals.

AAD dB	0-23	24-47	48-71	72-95	> 95
% hearing neighbours noise	49.5	74.5	73.5	78.0	90.5
% bothered (quite + v.much)	13.6	12.4	16.2	24.2	45.8
* Insulation rating (median)	2.1	3.0	3.2	3.3	4.4
+ Expectation score (median)	3.0	3.4	3.5	3.4	4.55

* V.good = 1, V.poor = 5 + Well above = 1, Well below = 5

While responses grouped in this way fail to show a really wide range of variation, the best indicator appears to be the direct rating of insulation quality. This, at least partly, is because the other indicators tend to be more greatly influenced by extrinsic variables such as how much noise particular neighbours make - in the case of the bother score - or socio-economic factors affecting the level of expectation, or the fact that the majority of occupants hear neighbours noise and tolerate a great deal of it.

All these indicators may be treated by correlation analysis, though for this purpose it is preferable to employ a finer division of the AAD scale. Dividing this by 5 AAD intervals yields 24 categories. Replies to all the main questions may be analysed by groups, of which there are 20. Alternatively, the total sample of 917 may be correlated individually with the AAD values ascribed to each dwelling. These results are summarised in Table 4.

Correlations of response variables with AAD dB Variable	r (Individual) n = 917	r (Group) n = 20
TV heard	0.3	0.71 (% hearing)
TV bother scale 1-5	0.34	0.75 (median scores)
Conversation heard	0.32	0.815 (% hearing)
Insulation rating scale 1-5	0.4	0.816 (median scores)
Insulation rated poor + v. poor	0.31	0.76 (% rating)
Insulation expected scale 1-5	0.36	0.71 (median scores)

Inspection of correlations and regressions for various noises heard and causing bother shows that these divide into airborne and impact noises. The former correlate highly with AAD, yielding sharp regression slopes, whereas the latter do not. In fact, the correlation for the impact noises rated most bothersome is negative ($r = -0.355$) while that for the most bothersome airborne noises is positive ($r = 0.454$) and the two regression slopes are in opposition.

This finding throws light on the fact that while the correlation of insulation rating with AAD is highly significant, the slope of the regression line is such that even at the highest standard of insulation it fails to reach the end of the scale so that there remain nearly 15% of the sample who rate their insulation as poor or very poor. The reason for this, as indicated by the negative correlation with impact noises, is that the responses are dictated by events which the AAD scale, as applied to houses, does not measure. The more the insulation succeeds in suppressing airborne sounds the more do occupants tend to hear impact noises. Although these are not on the whole very annoying, occupants register their occurrence in rating the quality of insulation.

The proportion of variance accounted for by any of these measures, although highly significant in the zero order correlations, may be further increased by taking account of intervening variables. The principal additional factors in group responses are the overall quality of the dwelling and occupational class, and for individual responses, the noisiness of the area, how much noise is made by neighbours, and noise sensitivity. One limitation on the employment of multiple regression is that many of the responses associated with noise from neighbours are highly intercorrelated, usually of the order of $r => 0.9$. More extended analysis, now in progress, may identify the most suitable variables to yield the highest level of accuracy in predicting the quality of sound insulation.

It is clear that numerous factors may intervene between sound insulation measurements and reports of neighbours noise, bother, or the overall assessment of insulation quality. Thus, there appear to be differences in response between owner-occupiers and tenants, occupants of semi-detached and terrace houses, and over the age range. But while statistically significant, these differences are not great enough to appear in multiple regression equations for overall assessment of insulation. Such differences are almost always in one direction, owner-occupiers having higher expectations of their dwellings, and rating the performance more critically, than tenants. Semi-detached dwellings are rated better for sound insulation - at equivalent AAD levels - than terrace properties, presumably because of having neighbours on only one side, and elderly occupants appear less bothered by neighbours noise than younger respondents. This may be partly because of impaired hearing, reduced activity and single occupancies, but also because of positive satisfaction and reassurance in hearing some sounds from neighbours. It is also interesting to note that the rating of sound insulation is weakly correlated with overall rating of house quality ($r = 0.38$ $p > 0.05$: $n = 20$). Thus as perceived quality of insulation falls, so does the rated quality of the dwelling. For this reason, poor sound insulation does not become predominant among spontaneously expressed criticisms of the dwelling as AAD increases. Although sound insulation is actually poorer, is rated worse, and reports of hearing neighbours noise and being bothered by it increase, it does not attain first importance, even at the lowest levels, because other, more basic requirements such as adequate heating, freedom from damp, and enough living space increasingly obtrude themselves.

A noteworthy feature of the overall results is the high degree of intercorrelation between all the response variables, both those covering different aspects of neighbours noise heard and causing annoyance, and between group and individual values of these. This suggests a high degree of self-consistency and reliability in response, and inspires confidence in the ultimate ability to assess insulation performance wholly in terms of occupants' requirements.

4 CONCLUSIONS

While general conclusions may be premature at this stage, and a full understanding of the various problems requires the completion of the parallel study of flats, two major findings may be commented on.

It is evident from the fact that at the highest standards of insulation a considerable proportion of the sample still remain dissatisfied, primarily because of impact noises such as banging doors, footsteps on stairs and electric switches and sockets in neighbouring dwellings, that the methods of measurement employed in houses may yield zero values of adverse deviation, yet nonetheless fail to guarantee complete satisfaction to the occupants. On the other hand, so far as airborne noises are concerned, the method of assessment is in close agreement with occupant experience.

Secondly, it becomes necessary to investigate whether any other means of calculating insulation values, such as that employed by the ISO norm, would yield assessments in closer correspondence with occupant experience.

REFERENCES

1 National Building Study Research Paper 27. 1958. Noise in three groups of flats with different floor insulations. London, HMSO
2 LANGDON, F J and BULLER, I B. 1977. Party wall insulation and noise from neighbours. J S Vib. 55, 4, 495-507
3 UTLEY, W A and ALPHEY, R S. 1974. A survey of the sound insulation between dwellings in modern building construction. BRS CP 52/74
4 SEWELL, E C and SCHOLES, W E. 1978. Sound insulation performance between dwellings built in the early 1970s. BRS CP 20/78