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Proceedings

NON PHYSICAL ASPECTS OF NOISE CRITERIA

Portsmouth Polytechnic
October, 1979

INSTITUTE OF ACOUSTICS

Non Physical Aspects of noise Criteria

CONFERENCE OBJECTIVES:

This conference and workshop, with such an ambiguous working title, aims to explore the nature and efficacy of criteria used by practicing acousticians, environmental hygienists, environmental health officers and others to assess and quantify human response to noise, especially those criteria used to assess psychological well being or confort. Over the years, some of us have come to accept the use of the dB(A) and more recently L_{Aeq} as a primary measurement

tool for assessing the human effects of energy and frequency content of a noise. While this tool will undoubtedly receive some attention during discussion this conference wants to focus its attention on broader issues and matters related to criterion aspects that presently receive less attention by researchers but cause the practitioner some of his largest headaches, namely - the allowances for impact noise, tonal components or socio-economic categories made in such standards as BS4142, the effects of low frequency and low level noise on human behaviour and the general influences of information content or meaning contained in a noise.

This conference aims to suggest a few ideas which will hopefully promote discussion amongst interested parties and lead to more appropriate research in this difficult but most stimulating area. It is seen by the organisers as a working seminar where all participants will have a chance to join the debate. The topic is especially relevant at the moment since the EEC are considering such problems in their own harmonisation programme.

Conference Programme

General: The morning session will consist of a series of papers related to the above objectives followed by a working session lead by a number of individuals who have been asked to stimulate an interesting and useful debate. Our aim will be to monitor that debate and summarise its findings. In order to help the chairman for the afternoon sessions it would be extremely helpful when returning your application slip if you could give us an idea of any questions you may have prior to the conference or areas of interest you fee should be exposed to debate. This information will hopefully help the chairman initiate a balanced debate. I include a separate sheet for this purpose.

Conference Details

9.45	- 10.15	Registration and coffee - BASEMENT FLOOR, Bar/Lounge, PHC (7.50 fast Waterloo train arrives at Portsmouth Harbour - the nearest station - at 9.45).

Formal Morning Session - Chairman - Dr Peter Lewis, School of Architecture UWIST

10.15	- 10.45	Annoyance caused by Low Frequency and Low Level Noise. Dr H.G. Leventhall, Chelsea College, University of London
10.45	- 11.15	The Impact and Tonal Allowance in BS4142 - Can they be measured and what do they mean? Dr James A. Powell, Portsmouth Polytechnic School of Architecture
11.15	- 11.30	Coffee and biscuits
11.30	- 12.00	Impact of Tones and Impulses on Subjective Response Dr John W. Leverton, Westland Helicopters Ltd.
12.00	- 12.30	Information - Important Parameters for Noise? Dipl-Ing Erich Schroder, Deutscher Arbeitsring fur Larmbekampfung e.V.
12.45	- 2.00	Buffet Lunch (in Bar/Lounge PHC)

Afternoon Discussion Session - Chairman - Dr John Langdon, Building Research Establishment, Watford

2.00	- 2.30	Stimulus Discussion Paper 1 - The Limitations of Physical Noise Criteria Dr Peter Lewis, School of Architecture, UWIST
2.30	- 3.30	Discussion
3.30	- 3.45	Tea
3.45	- 4.15	Discussion Stimulus Paper 2 - Psychological Determinants of Noise Nuisance. Are there any? Ian Griffith, W.S. Atkins and Partners, Epsom
4.15	- 5.15	Discussion
5.15	- 5.30	Closing Summary - "where do we go from here?" by Dr James A. Powell, Portsmouth Polytechnic School of Architecture

Note: Fast trains return to London every 45 minutes to the hour from the Harbour Station.

Proceedings of The Institute of Acoustics

ANNOYANCE CAUSED BY LOW FREQUENCY/LOW LEVEL NOISE

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Noise criteria are, in general, deficient in dealing with low level noise and are particularly so when the noise is of low frequency as well as of low level. Significant changes at the low frequency end of the spectrum may have a negligible effect on the dBA level, but be clearly perceptible. In general, low level/low frequency noises become annoying when the masking effect of higher frequencies is absent. This can occur, for example, in the transmission through walls and in propagation over long distances, since in both these cases higher frequencies are attenuated more readily. An important factor appears to be the rate of fall of the spectrum into the mid and higher audio frequency ranges. The more rapid the fall-off, the more annoying is the noise.

The assessment of subjective response to low frequency noise is complicated by the individual differences which exist, particularly in the region of threshold. A situation often arises in which only one person in a household is affected by a noise and this results in additional stresses produced by their isolation.

Several factors may contribute to the wide range of individual differences. These include: (a) People are different. (b) It is known that in the low frequency region that equal loudness contours are closer together than at middle frequencies. This results in a more rapid growth of loudness sensation with level change. (c) The pronounced deviations which are known to occur in the microstructure of the detection threshold curve at higher frequencies may also extend into the lower frequencies. For example, it is known that in the region of 1000 to 1500 Hz the threshold may vary by 15 dB over a range of about 20 Hz. This microstructure is ignored in normal audiometric measurements. However, if it is shown that the lower frequency region, i.e. 10 to 100 Hz, is also subject to similar fluctuations, an explanation for the wide differences in individual response could follow.

A well-known, but unfortunate, phenomenon in the low frequency region is that of "tuning in". This is the situation in which the noise grows on you in a way which implies a time dependent sensitivity, being the reverse of the accommodation to noise which often occurs at higher frequencies. The subject becomes increasingly sensitive to the noise throughout a period of exposure and may develop physical symptoms which cannot be explained in terms of direct action of the noise on the body. The symptoms are typical of those produced by stress, e.g. headaches, pains in the neck, arms and legs, digestive disorders. These symptoms can be produced by noises at very moderate dBA levels.

A further effect is related to whether the noise source is identifiable or unidentifiable. If the source is identifiable, then there is a focus for the complaints about the noise, but it is not always possible to achieve a satisfactory result. For example, the Environmental Health Officer might be called in, but on the basis of the dBA reading which he would normally take, he may say that he cannot find any justifiable cause for complaint. Further,

if he himself cannot hear the noise, he would find it very difficult to be able to press matters on behalf of the complainant. An unidentifiable source presents particular difficulties which are again magnified if only a few people hear the noise. What can you do about such a noise if you do not know where it comes from? This is the situation with many examples of environmental noise complaints.

A further complicating factor is the possibility of low frequency tinnitus. Our own work has convinced us that some low frequency noise complainants do suffer from tinnitus, just as we are equally convinced that some do not. One should not take the easy way out and dismiss all complainants as tinnitus sufferers, although this is, perhaps, more likely to be true when only one person hears a noise from an unidentified source. There is always the possibility of an unfortunate combination of a spectrum peak in the noise with a sensitivity peak in the threshold. Further, there is the possibility that even for wide band noise, adjacent peaks in threshold sensitivity could produce the throbbing effect which is so often complained of. There is, as yet, no hard evidence to support these suggestions, but they are put forward to indicate the need for continued tolerance and sensitivity in dealing with complainants.

Some examples of annoying low frequency/low level noises are as follows: Fig. 1 shows two examples of noise in living accommodation from adjacent premises. Both occurred in Central London and were causes of persistent complaints leading to threats of legal action. The levels are low, but a one third octave analysis of this type does not reveal the true nature of the noises, which both had an unpleasant throbbing characteristic at about once per second. This made the noises noticeable and unpleasant, rather than their average levels. Fig. 2 gives the noise from an adjacent boilerhouse. The analysis shows average levels and, although the average levels are beneath the normal threshold, fluctuations could exceed the threshold and be a cause for complaint from a particularly sensitive person. No known criteria could have judged this noise to be excessive, but persistent complaints resulted in an abatement order. However the complainant moved house before work could be carried out. Fig. 3 is an example of lift noise. The location was particularly quiet at night and the noise is more than 10 dB above background. The complaint was of sleep disturbance at night. Assessment of the noise in terms of, for example, Leq, gives only a small increase above background because of the few lift movements involved. However, if somebody complains of being woken up two or three times an hour through the night, it is no help to tell him that the average level is still quite low. Clearly, a sleep disturbance criterion is required. This case resulted in legal action against the landlords (the local Council) which was settled out of court with several thousand pounds compensation and a move to another flat. Fig. 4 illustrates an environmental noise from an unknown source. The complainant was able to distinguish the level change, although the experimenter could not hear either noise. This analysis is also an average, so that fluctuations could be somewhat greater than the levels shown.

These instances of annoyance by low frequency noise indicate the need for expansion of existing criteria. Are we going to have criteria which cover the most sensitive people, as well as those of average sensitivity? How are we going to assess a throbbing characteristic of a noise and how are we going to account for sleep disturbance, individual threshold difference and tinnitus?

ANNOYANCE CAUSED BY LOW FREQUENCY/LOW LEVEL NOISE

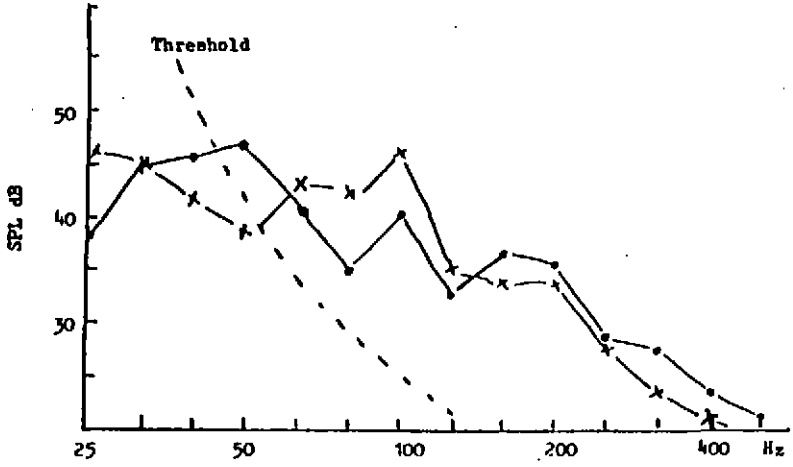


Fig. 1 Noise From Adjacent Premises

—●——●— Dry cleaners 31 dBA

—×——×— Air conditioning plant 32 dBA

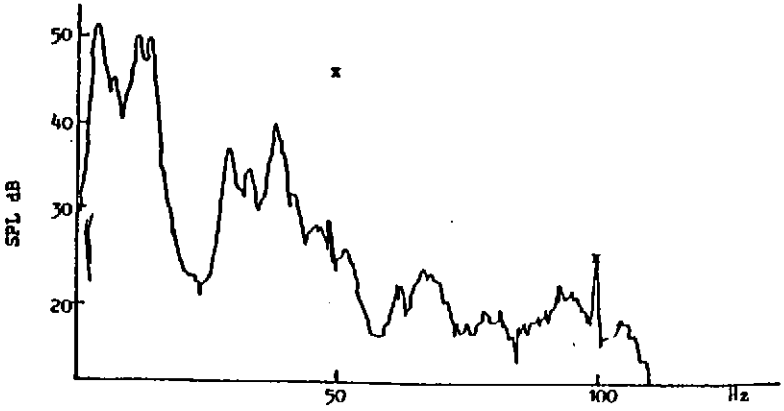


Fig. 2 Boiler House Noise in Adjacent Flat

x Threshold Levels

ANNOYANCE CAUSED BY LOW FREQUENCY/LOW LEVEL NOISE

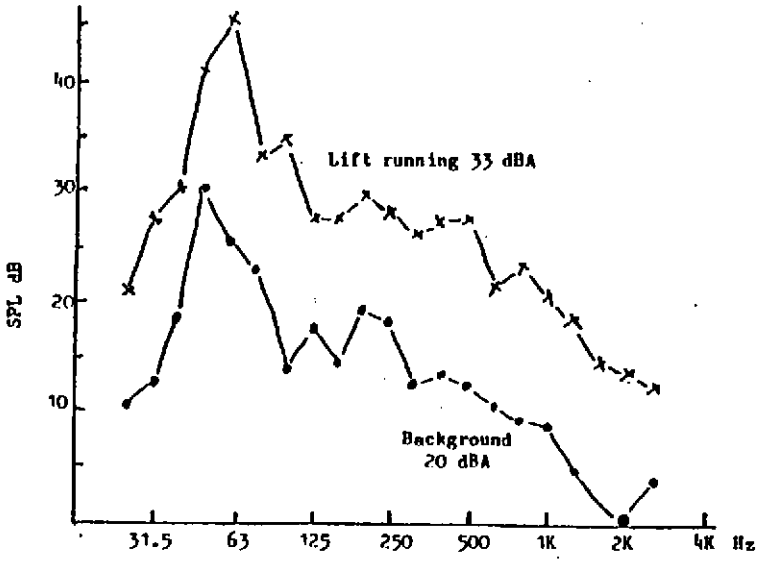
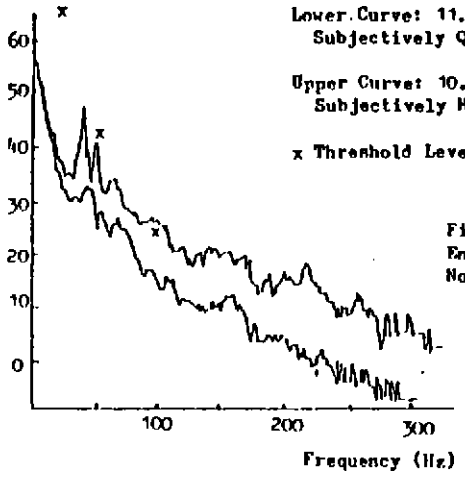


Fig. 3 Lift Noise



Lower Curve: 11.35-11.40 p.m.
Subjectively Quiet

Upper Curve: 10.45-10.50 p.m.
Subjectively Mild-Heavy

x Threshold Levels

Fig. 4
Environmental
Noise