Proceedings of The Institute of Acoustics

THE EFFECTIVENESS OF INSULATION MEASURES AGAINST TRAFFIC NOISE

J W Sargent

Building Research Establishment

SUMMARY

Since 1973 the UK has had regulations which require that a noise insulation package is installed in dwellings subjected to high levels of noise from new or modified roads. The Building Research Station have carried out an investigation into the effectiveness of the package and its acceptability to residents.

To provide data on the effectiveness of the package, noise insulation measurements over a frequency range 31.5 Hz to 3150 Hz were made on more than 150 installations which had been treated under the Noise Insulation Regulations. A questionnaire survey was used to determine the attitudes of 900 residents to the package. The questionnaire sought their responses as to the effectiveness of each component of the package and the acceptability of the resulting acoustic, thermal and ventilation conditions in the dwelling.

The average noise reduction of a treated facade was found to be 34 dB(A) and, overall, the package of insulation measures was considered satisfactory by 84% of respondents.

The measured performance of the package is described including spectral information, variability of performance and comparison with the noise insulation of untreated facades. Details of the results from the subjective study are discussed showing how effective the respondents consider the package to be at providing an acceptable indoor environment and how the level of response varies with external noise level.

THE EFFECTIVENESS OF INSULATION MEASURES AGAINST TRAFFIC NOISE

INTRODUCTION

Regulations in England and Wales dealing with the insulation of residential property against traffic noise arising from new or improved roads came into effect in 1973. The object of the regulations was to enable residents subjected to additional noise at or above a specified level caused by the use of new or improved roads, to benefit from a reduction in noise level inside their dwelling. This was achieved by means of double windows whilst ventilation and solar gain control were maintained with a room ventilator and where appropriate, venetian blinds. The cost of this work was to be borne by the highway authority constructing the new road. During the last ten years well over 30,000 dwellings have been treated under the scheme.

The Building Research Station has recently undertaken a study into the effectiveness of the measures provided under the Noise Insulation Regulations (1) and the acceptability of the measures to the residents.

THE REMEDIAL PACKAGE

To protect the internal environment of a dwelling against external noise it is necessary to keep windows closed. By fitting double windows with a wide cavity between the panes further protection can be provided. Taking these measures may cause other problems such as overheating and inadequate ventilation. The package of remedial treatment consists therefore of four elements, double windows, venetian blinds, a powered ventilator and a permanent vent. Detailed specifications for each of these elements are contained in Regulations (1).

INSULATION PERFORMANCE

The sound insulation performance of the remedial package has been measured for 154 treated rooms at 27 sites. Simultaneous tape recordings were made for 15 minutes outside and inside each insulated room. The outside microphone was placed 1 metre from the facade and the inside microphone moved to three positions within the room. The recordings were analysed in dB(A) and 1/3rd octave bands in terms of L10. This analysis was carried out using a real time analyser and minicomputer. The figure shows the mean value of 1/3rd octave sound level differences measured over the frequency range 31.5 Hz to 3150 Hz. The dashed lines show the area within which 90% of the measured values lie. The sample of 134 facades were those measured which had the ventilators in a usable condition. That is they had not been blocked up or taken out by the residents.

The mean dB(A) value of level differences was found to be 34 dB(A), however the highest was 41.5 dB(A) and the lowest 25 dB(A). The results show that the differences in traffic noise spectrum from site to site account for some of the variation in measured dB(A) level differences. For example at one dwelling where the insulation in 1/3rd octave bands was substantially the same in the living room and the bedroom the level difference was 5 dB(A) less on the ground floor where a wall between the road and the house had reduced the high frequency noise and produced a spectrum with relatively greater low frequency content.

THE EFFECTIVENESS OF INSULATION MEASURES AGAINST TRAFFIC NOISE

The average level difference over the frequency range 100 - 3150 Hz and the weighted sound level difference using the rating method in BS5821(2) were also determined and both these values were invariably found to be higher than dB(A) differences.

To make a comparison of the performance of the insulation package with that of untreated windows found alongside busy roads the insulation of 100 untreated windows have been measured. Table 1 shows the average level difference for the various types of window measured.

TABLE 1

	dB(A)level difference	No. of windows measured
Package double windows	34	134
Single wooden Casement	29.3	20
Single wooden Sash	28.2	10
Single louvred windows	25.1	6
Single metal casement	27.6	20
Replacement thermal double windows	33.2	42

The package double windows have a better performance than the replacement thermal double glazing at the higher end of the frequency spectrum.

A SURVEY OF ACCEPTABILITY

A questionnaire survey of almost 900 residents has been carried out at 24 sites subjected to noise levels from 68 - 82 dB(A) L_{10} (18 hrs). The questions can be divided into a number of broad categories. The initial questions were concerned with the likes and dislikes of the area and the dwelling, this being given as the subject of the interview. The next set of questions concerned details of the dwelling including which rooms had been treated and the type of heating used. There followed a series of questions concerned with the respondents feelings about individual items of the package and these were followed by a section dealing with attitudes to noise. The next section was concerned with the other aspects of the internal environment in the dwelling and included questions about thermal and ventilation conditions and about condensation. The questionnaire concluded by seeking the respondents attitudes to the remedial package as a whole.

A large majority (89%) liked the double windows. The main advantage was considered to be that they kept out the noise but some respondents liked them because they conserved heat and reduced draughts. The main disadvantage of the double windows was that they were difficult to clean. The venetian blinds were also generally liked (78%) but a significant proportion of residents (39%) disliked the ventilators. The main disadvantages concerned their appearance and the fact that they let in draughts.

The reduction of noise produced by the installation of the package appears to be sufficient to produce an acceptable internal noise environment in most cases. The level of traffic noise in their insulated living rooms was considered satisfactory by 84% of respondents while only 3% were very bothered by this. The situation was considered to be only slightly less satisfactory with regard to bedrooms.

During summer the temperature in living rooms was considered to be more comfortable after the package was installed by 34% of respondents while only 12% considered it less comfortable.

Only 10% of respondents reported more condensation after the package was installed whereas 25% said they had less.

It is interesting to note that many people continue to open windows for fresh air in insulated rooms. This is more common in bedrooms where windows may be opened during the day when rooms are not occupied. There is some evidence that the number of people opening windows in insulated rooms is less than in uninsulated rooms. Approximately half of respondents claim that they never use the fans in the ventilator units in order to provide fresh air. Of those who use the ventilators almost three-quarters consider that the units give enough fresh air on their own. The ventilator specification includes a restriction on the noise generated by the fans themselves. As a result, fan noise does not seem to have been a general problem although 15 - 20% of respondents who used the fans found the noise they generated disturbing.

REFERENCES

1. Statutory Instrument 1975 No.1763, Noise Insulation Regulations 1975. HMSO 1975.

2. British Standard BS5821:1980. Method of rating sound insulation in buildings and building elements. British Standard Institution 1980.

Reduction of road traffic noise (L_{10}) provided by double windows installed under the 'noise insulation regulations'