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SCALE MODEL EXPERIMENTS ON NOISE REDUCTION BY ACOUSTIC BARRIER FOR SOME CONFIGURATIONS OF NOISE SOURCE

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1. Introduction

Recently noise control by acoustic barriers has become a popular method of environmental protection. Many experimental and theoretical studies have been carried out on the effect of noise reduction and diffraction by barriers. Maekawa's results, particularly, are extensively used for the design of an acoustic barrier, but this can be applied in the case of a point source. However, in the practical situation, there are often many cases where the dimensions of the noise source are significant. In such cases, the noise source is regarded as an aggregate of many point sources. For each point source, noise reduction by an acoustic barrier can be estimated from the figure published by Maekawa (1), and then the sound pressure levels corresponding to all point sources are summed up at the receiving point. However, it is considerably difficult to simulate the practical noise source as an aggregate of the point propagation over the complicated surfaces and obstacles presented by, for example, buildings, undulating land, acoustic barriers having various shapes, etc. For these problems, it would be useful to apply a method based on scale model experiments.

Here we will describe a few experiments on noise reduction by an acoustic barrier for some configurations of noise source.

2. Experimental Study of Noise Reduction by Acoustic Barrier for Some configurations of Noise Source

2-1 Noise Sources used for the Model Experiments

Details of the noise sources used for model experiments are shown in Fig.1. The outside crusts of these noise sources are constituted of polystyrene boards which are 9mm in thickness. The inside of the crusts are rubbed by a cylindrical rotating brush with long bristles, which is revolved by an electric motor; thus broad band noise is radiated continuously from each part of the surfaces of the source and has random characteristics in phase. Frequency characteristics of noise radiated from the sources are shown in Fig.2.

The noise sources used in these experimental studies have several advantages, such as stability, easy-handling, incoherency and so on; so that it was suitable for this kind of model experiments.

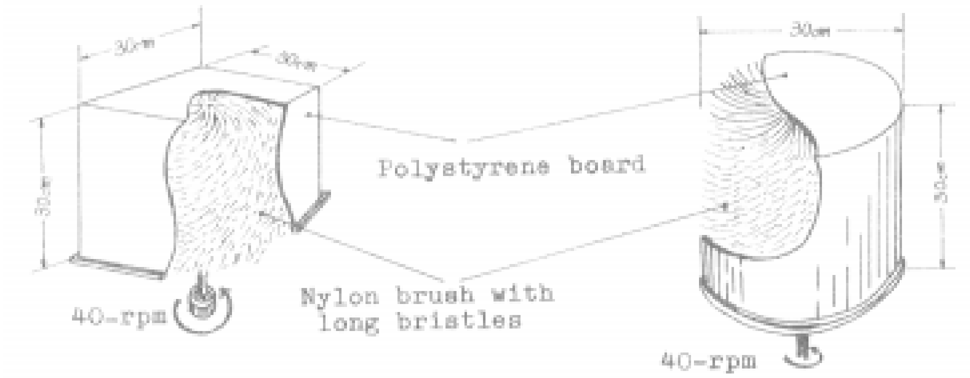
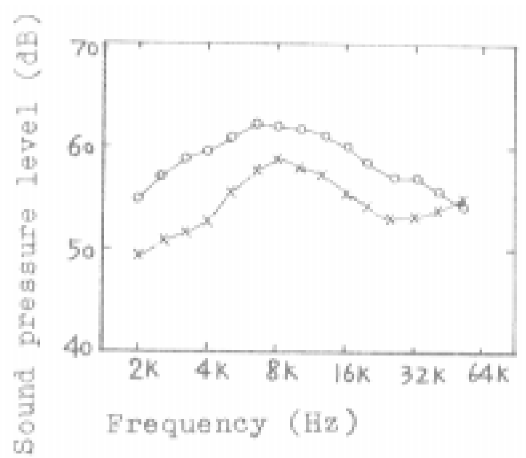


Fig.1 Details of the noise sources used in model experiments. (A cubic source and a cylindrical source)



(measured at a distance 100cm from center of the sources. One-third octave band)
—◦— Cylindrical source
—×— cubic source

Fig.2 Frequency characteristics of noise radiated from the sources.

2-3 Experimental Procedure

Experiments were carried out in a semi-anechoic room, which has sound reflective floor. The acoustic barriers used for the experiments were made of lead plate of 2mm thick. Acoustic barriers of various shapes and with various absorbing conditions of inside surface ware set around the source, and the spatial distribution of sound pressure level was measured. Sound absorbing material sticked on the inside of the barriers were felt blanket of 10mm thick.

For the measurements, a 1/4 inch condenser microphone was used. The measurements of sound pressure level were carried our at the center frequencies of 2000, 4000, 8000 and 16000 Hz, by inserting a onethird octave band pass filter in the receiving apparatus. The experimental set-up of the source, barrier and the microphone are shown in Fig.3.

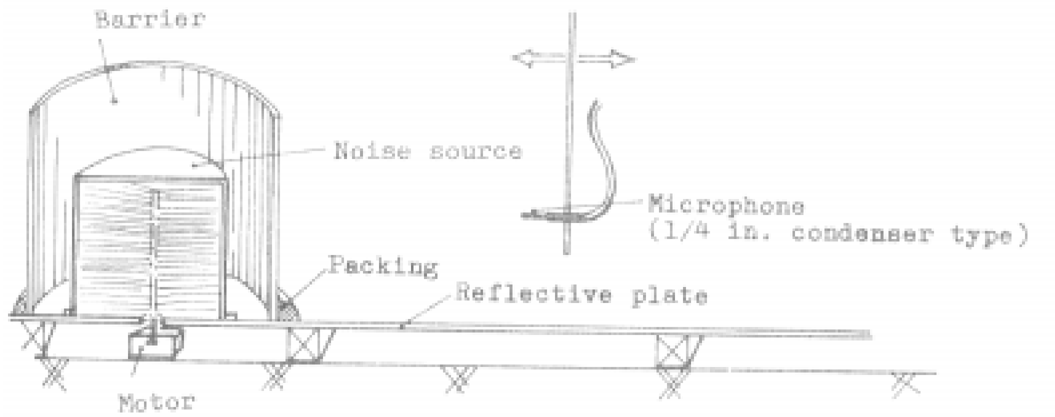


Fig.3 Experimental set-up.

2-3 Experimental Results

Two cases of the measured spatial distribution of sound pressure level in a plane involving the vertical axis of the noise source were shown in Fig.4 as curves of equal excess attenuation at 8000Hz for a 50cm high circular barrier which was set around a cyrindrical noise source of 30cm in height. That is, the results obtained for the conditions of reflective and absorptive inside surfaces of the barriers were plotted in Fig.4(a) and 4(b) respectively. In cases where the inside surface of barrier was reflective, a rise up of the sound pressure level at the above space of the source has been observed, and the excess attenuation were lower than for the cases where the inside surface was absorptive.

In Fig.5 the excess attenuation of sound pressure level measured in a radial direction at the height of 15 and 30cm above the ground were shown.

To carry out the effective noise control by surrounding some configurations of noise source with barrier it is necessary to make the inside of the barrier absorptive. In the case where the inside of the barrier is reflective, multiple reflection occurs between the surface of the source and the inside of the barrier, and for this reason it was supposed that the noise attenuation by barrier would be lower.

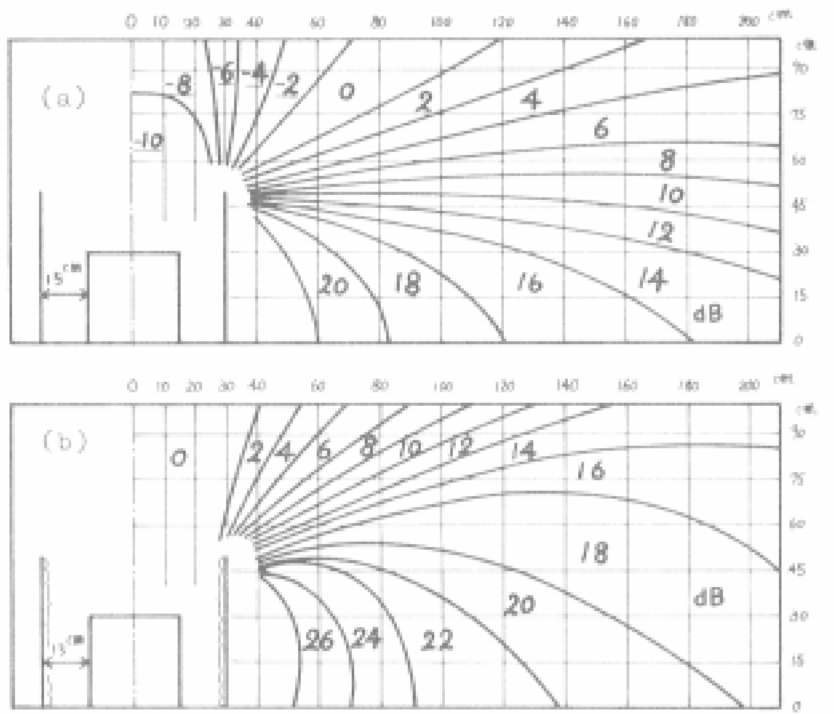


Fig.4 Curves of equal excess attenuation at 8000Hz for a 50cm high circular barrier set around a cyrindrical source. Inside surfaces of barriers, reflective (a) and absorptive (b).

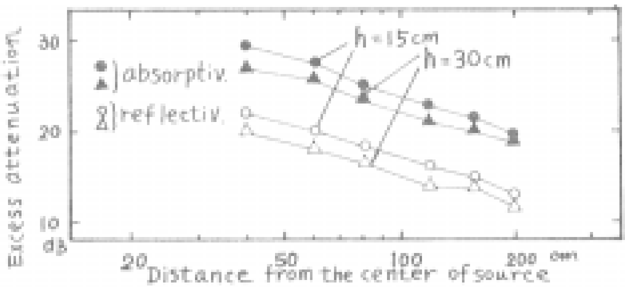


Fig.5 Excess attanuation measured in a radial direction.

By supposing to set the four point sources as shown in Fig.6, Fig.7 were obtained by the calculation of the excess attenuation using Maekawa's diagram at each receiving point.

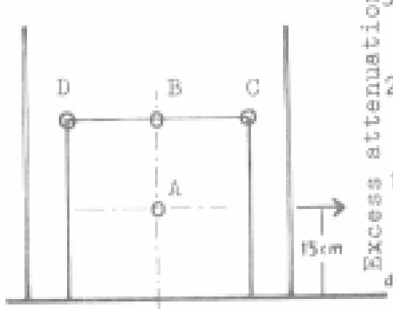


Fig.6.

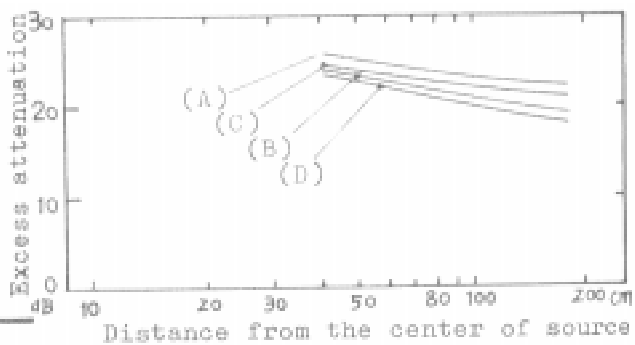


Fig.7 Excess attenuation calculated using Maekawa's diagram.

(1) Z.Maekawa, Noise redution by screens, Apple.Acout.1 (1968), p.157.