inter.noise 2000
The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE

I-INCE Classification: 3.1

EFFICIENCY OF HIGHWAY NOISE BARRIER WITH HORIZONTAL LOUVER - A STUDY BY FULL SCALE MODEL EXPERIMENT

T. Matsumoto*, K. Yamamoto*, H. Ishikita**

* Kobayasi Institute of Physical Research, 3-20-41 Higashi-Motomachi, Kokubunji, 185-0022, Tokyo, Japan

** Metropolitan Expressway Public Corporation, 2-25 Masago-cho, Naka-ku, Yokohama-shi, 231-0016, Kanagawa, Japan

Tel.: +81-42-321-2841 / Fax: +81-42-322-4698 / Email: matsu@kobayasi-riken.or.jp

Keywords:
ROAD TRAFFIC NOISE, NOISE BARRIER, LOUVER

ABSTRACT
The efficiency of the highway noise barriers with horizontal louver is investigated by full scale model experiments. By comparing A-weighted sound pressure levels with a conventional barrier with the same height, excess noise attenuation of 2.5dB is obtained at a distance less than 15m from the barrier.

1 - INTRODUCTION
In recent years, due to the heavy increase in noise level around highways, barriers of 8m height have been installed for the countermeasure against vehicle noise in Japan. However, this may cause secondary problems such as narrow range of driver's sight, poor aesthetics. Furthermore, wind load increases for tall barriers that are applied to elevated highways. Therefore, low barriers with high efficiency for noise reduction are required.

A type of highway noise barrier has been designed to possess both acoustical and non acoustical benefits such as amenity for residents and drivers. One idea for the non acoustical benefit is to apply apertures to barriers. In the design, absorptive louver blades are applied to barriers so that the acoustical performance of the barrier can be improved. The barrier, i.e., horizontal louver, looks like sun shading blinds. The acoustical performance of this type was already examined by 1/20 scale model experiments and the test results showed several advantages compared with the conventional acoustical barrier [1]. In this study, highway barriers with the horizontal louver were manufactured in full scale. The efficiency of barriers against the highway noise was investigated.

2 - FULL SCALE MODELS
A trial product of the highway noise barrier with the horizontal louver for testing is shown in Fig. 1. The barrier consists of absorptive louver blades. The thickness of the blade is 300mm and the width is 583mm. The blades with elliptical shape in cross sectional view are arranged in H-beams with equal spacings at an angle of 45 degrees. Thus, the width of the barrier is 500mm. The apertures are in an upward direction. Two types of test barriers are produced, i.e., Type A and Type B. Type A is made of polyester fiber (Fiblight) with 100mm thickness, a density of 30kg/m ^{3} and water-resistant surface as absorptive material. Type B consists of glass wool with 100mm thickness, a thin film of polyvinyl fluoride (PVF) to waterproof, textile glass fabrics and steel sheet with perforated facing. The conventional straight barrier which is used by Metropolitan Expressway Public Corporation is taken as a reference to determine the efficiency of the newly designed barriers.

3 - EXPERIMENTAL PROCEDURE
Full scale tests were carried out to simulate a section of the elevated highway with two lanes. A test facility was set up on the roof of a building whose height is 8.1m above the ground. Figure 2 shows a

Figure 1: A trial product of highway noise barrier with horizontal louver.

cross sectional view of the test facility and the measuring points. Three types of barriers, which were Type A, B and the reference absorptive wall, were set on the near side to the measuring points. The far side employed the conventional absorptive barrier throughout the study. These barriers were 7.5m long. The distance between the barriers was 9m. In order to ignore sound paths around the side edge of the test wall, high performance absorptive barriers were installed perpendicular to the test barrier. Instead of a parapet, a 1m barrier of steel panel with a reflective surface is used. Heights of all barriers are limited to 2m above the steel panel. The measuring points were located behind the barrier above the flat asphalt surface. Pink noise was used as a test signal, and was intermittently radiated from a loud speaker that was placed at distances of 3m and 6m from the near side barrier and at a height of 0.5m on the roof. The frequency range used in the experiment was from 160Hz to 5kHz. The on and off time was 2.5 seconds, alternately. One-third octave band sound pressure levels were measured by synchronized integration technique. The data is the average of three

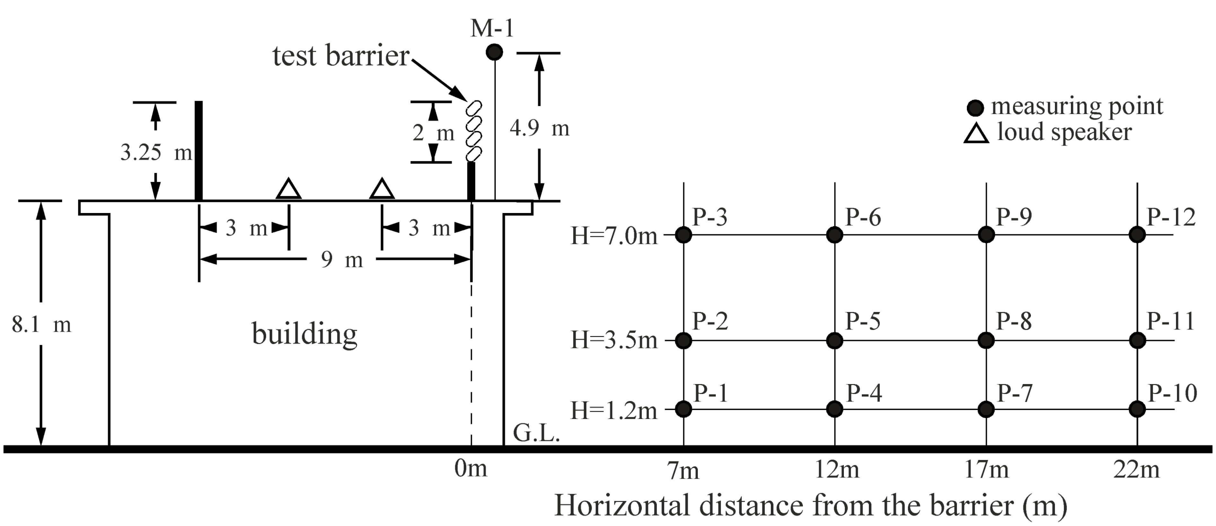

Figure 2: Cross sectional view of test facility and measuring points.

measurements for each source position. The averaged levels measured with the speaker in the two positions were combined logarithmically to obtain the total noise level. This total level represented the noise from simulated traffic in both lanes. Road traffic noise was simulated by adjusting the spectrum to that of a mean value of vehicle noise in A-weighting.

4 - EFFECT OF BARRIERS

The acoustical performance of the barrier was evaluated by the noise attenuation which exceeded that of the reference barrier. The levels were normalized for a source level from each speaker position of 100dB (near side source) and 95dB (far side source) at the reference point. The reference point (M-1) was located 1.65m above the top of the barrier (see Fig. 2). Fig. 3 shows a comparison of the excess noise attenuation for one-third octave band frequency. The thick line shows Type A, the dotted line is Type B. At the measuring points of P-1, P-2, P-4 and P-5, the excess noise attenuation of type A is 2dB to 5dB above 315Hz. For Type B, sound pressure levels is 1dB to 8dB greater than the conventional straight wall above 1kHz at all microphones.

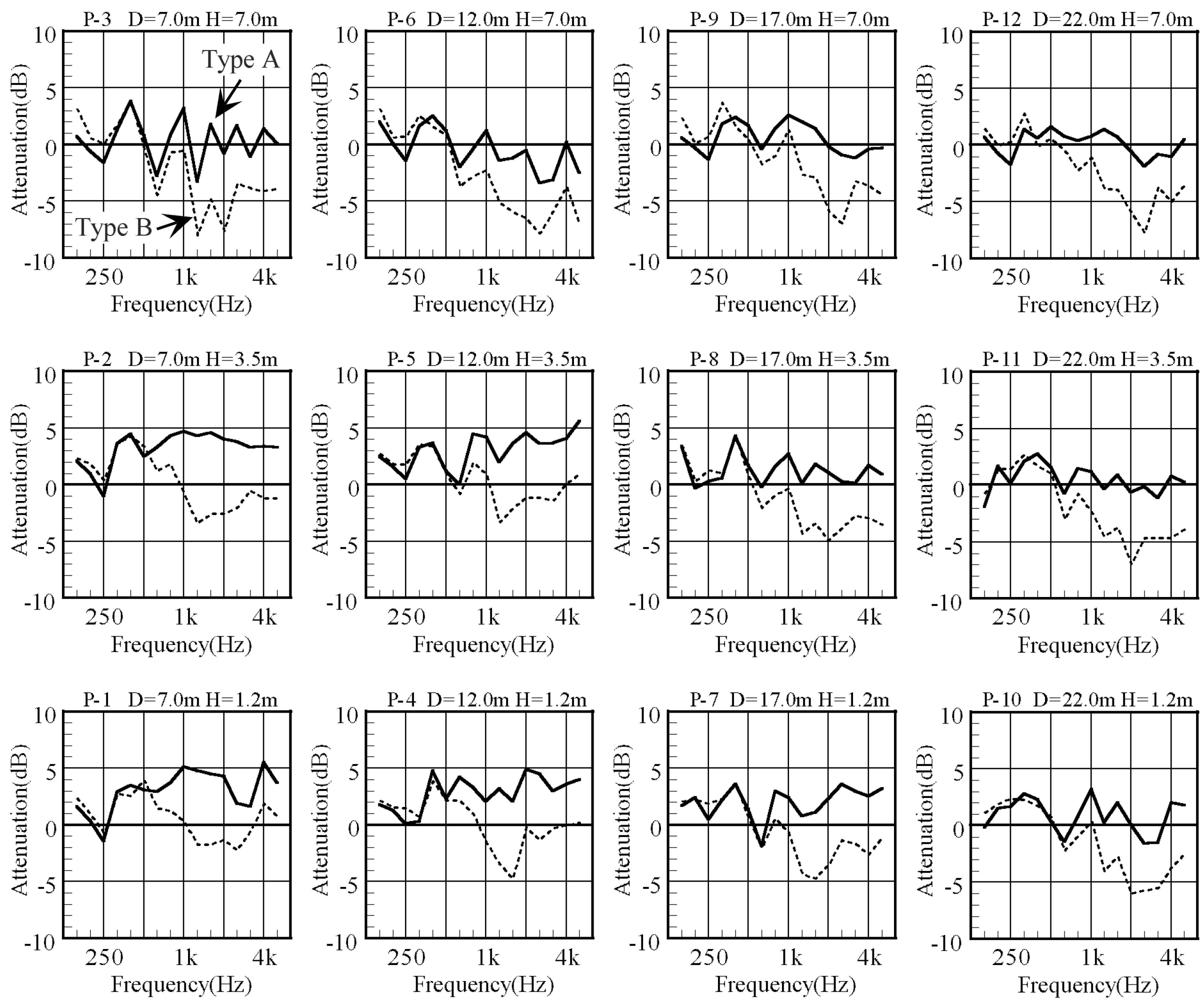

Figure 3: Excess noise attenuation for one-third octave band frequency.

The cross sectional distributions of the excess noise attenuation are shown in Fig. 4. The excess noise attenuation of Type A shows 2.5dB at a distance of less than 15m from the barrier. For Type B, sound pressure levels are greater than the reference wall at the measuring points whose height are 7m above ground level and the horizontal distance of more than 22m from the barrier. This increase is caused by the sound leakage through the apertures of the barrier, so that the absorptive coefficient of Type B blade is lower than Type A. Therefore, applying high absorptive material to the blade surface is favorable to the improvement of the efficiency of the barrier with horizontal louver.

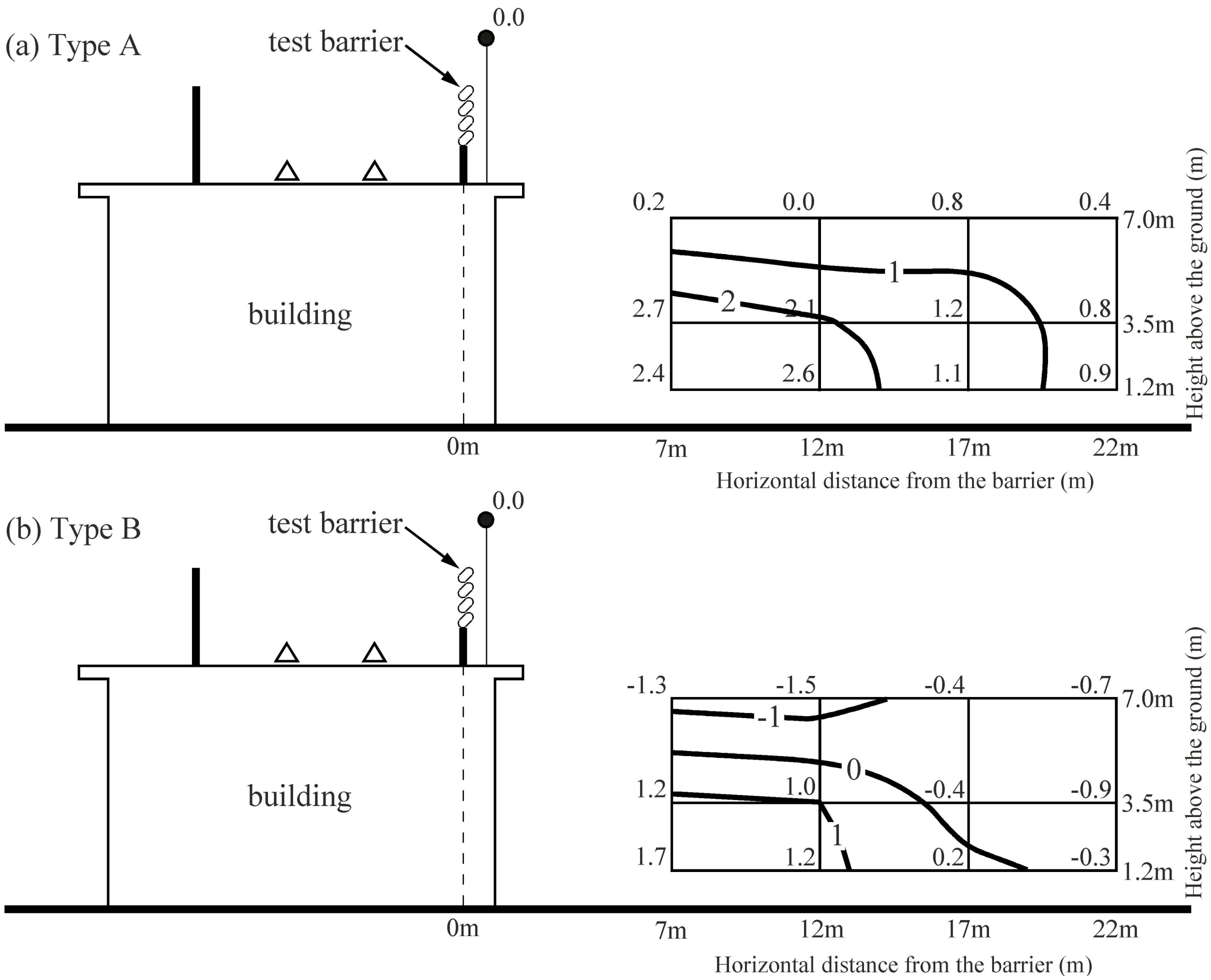

Figure 4: Cross sectional distributions of the noise attenuation for A-weighted vehicle noise.

5 - CONCLUSION

Full scale model experiments have been carried out for highway noise barriers with horizontal louver. The test results show that the additional attenuation greater than 2.5dB can be obtained for type A in which polyester fiber is applied as absorptive material. The application of this type may help to solve the noise problem and non acoustical demerits of barriers.

ACKNOWLEDGEMENTS

This study was greatly supported by BRIDGESTONE CORPORATION.

REFERENCES

1. **T. Matsumoto, K. Yamamoto, K. Iimura and G. Sakamoto**, Scale model studies of new type highway noise barriers, In *Proceedings of inter noise 94*, pp. 579-582, 1994