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FULL SCALE TESTS ON THE DESIGN OF RAILWAY NOISE BARRIERS

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1 INTRODUCTION

Where railways run close to populated areas, noise barriers are often demanded. The barriers are usually made of wood, steel or concrete, i.e. a vertical and sound reflective barrier. In this paper some ideas on how to improve the insertion loss of a railway noise barrier are presented.

2 SOME IDEAS ON BARRIER DESIGN

In Sweden a railway noise barrier is normally placed at least 4 m from the centre of the track. The distance is determined by safety regulations and it is also used to give space for snow clearance. To restrict the height is also desirable in order to keep an open view. For Swedish trains this means a maximum height of approximately 2 m above the rail.

With a vertical sound reflective barrier the noise will be reflected between the railway cars and the barrier. The reflections reduce the effectiveness of the barrier. The closer the train runs to the barrier, the larger is the reduction.

The most obvious solution to this problem is to mount a sound absorbing material on the inside of the barrier. Sound absorbing materials also change the diffraction of the sound waves over the edge of the barrier which can improve the insertion loss. The effect of sound absorbeing materials has been thoroughly investigated, see e.g. [3].

Also an inclining barrier could be expected to reduce the effect of multiple reflections. The barrier could be inclined inwards, towards the track or outwards. A barrier inclining inwards will reflect the noise to the ground. Inclining the barrier outwards means that the reflections are directed upwards. However, an inclining barrier also changes the sound wave diffraction over the edge of the barrier.

The insertion loss can also be improved if one or more extra barriers are mounted parallel to each other separated by an air space [1]. The extra barriers do not have to be on separate foundations. Significant improvements can be reached by attaching panels to a single foundation barrier.

3 MEASUREMENTS

The existing barrier
The barrier consists of a cover boarding of 32 mm thick vertical boards. The height is 2.7 m above ground and 2.2 m above the rail. Due to drying and ageing of the wood up to 10 mm wide slits has occurred. Also there are gaps between the barrier and the ground. Therefore the barrier was sealed with cardboard.

Tested designs
The tests were carried out on a 60 m segment of the existing barrier. Six cases were tested, see Figure 1.

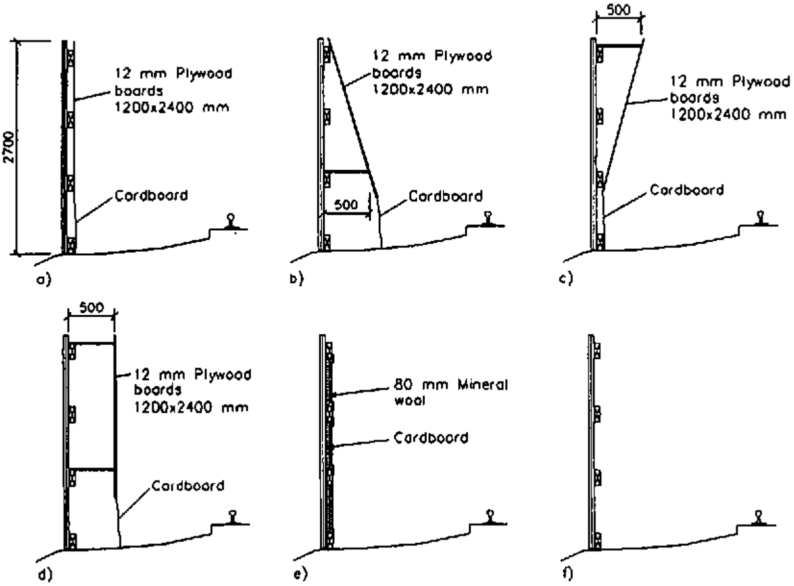

Figure 1 Design tests on an existing barrier.
a) plywood boards and cardboard fitted to the barrier to seal the gaps
b) plywood boards inclining from the track
c) plywood boards inclining towards the track
d) plywood boards vertical, 500 mm from the existing barrier
e) 80 mm mineral wool attached directly to the barrier, barrier sealed with cardboard.
f) existing barrier without sealing

Method

Two microphones were mounted on the shadow side 15 and 30 m from the barrier, see Figure 2. A reference microphone was mounted on the inside of the barrier beside the section were the barrier was modified. The signals were recorded on a multi-channel DAT-recorder. The microphones were screened to reduce the influence of sound coming from outside the treated parts.

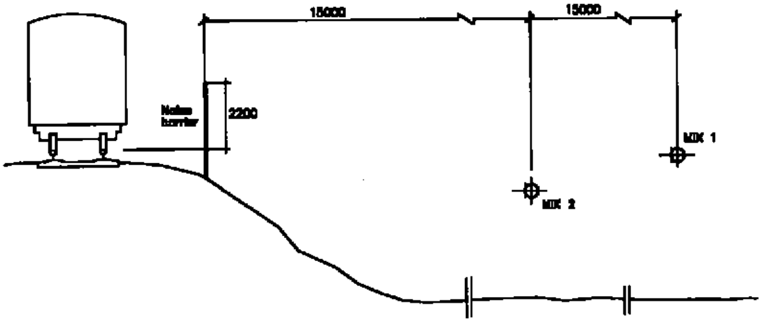

Figure 2 Section of measurement set-up.

The recorded signals were analysed in octave bands from 125 to 4000 Hz. The equivalent sound pressure levels were calculated for a period of 2.5 s centred around the maximum value. In most cases the analyses comprises 10 passages or more. The sound pressure levels at microphones 1 and 2 was subtracted from the level at the reference position, thus reducing the influence of different speed etc. The values for the different design cases were compared with case a) barrier sealed with plywood and cardboard.

Results

The effect of the different design cases is shown in Table 1. The values show the improvement of insertion loss relative case a) (barrier sealed with plywood and cardboard) as an average of the two microphone positions. A positive value means that the insertion loss has been improved.

Table 1 Improvement of insertion loss rel. case a) [dB].

Octave band [Hz]	*125*	*250*	*500*	*1000*	*2000*	*4000*	*dB(A)*
b) plywood inclining from the track	-1	0	0	-1	0	-2	0
c) plywood inclining towards the track	1	1	3	2	4	6	3
d) plywood vertical, 0,5 m from barrier	5	6	6	7	4	3	4
e) mineral wool	1	3	3	3	4	6	3
f) existing barrier	-3	-4	-4	-4	-5	-2	-4

4 DISCUSSION AND CONCLUSIONS

The measurements show that the largest effect is achieved with multiple-edge barriers and mineral wool. Since these measures are practically independent of each other, a combination of the two measures could be expected to yield a large improvement.

Inclining the barrier outwards had no significant effect. Inclining the barrier inwards towards the train improved the insertion loss, but the improvement is probably due to the effect of the double-edge barrier. Thus, the inclining in itself seems to have a negligible effect.

The measurements also show the importance of a construction that stays airtight.

5 ACKNOWLEDGEMENTS

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6 REFERENCES

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