The railway bonus as a single value: the effects of this simplification

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Introduction

Around 20 years ago, as part of the deliberations about the Traffic Noise Protection Act, which was then being planned in Germany, the "railway bonus" entered the discussion for the first time. The basic premise was that the nuisance effect of rail and road traffic noise should be evaluated using a uniform limit value and that the category scale Lm should be used as the designatory unit. On the basis of studies prepared at the time, the difference in the nuisance effect of rail and road traffic noise was calculated with a railway bonus of 5 dB(A); that is, it is assumed that rail traffic noise is perceived as being 5 dB(A) less of a nuisance, when converted, than road traffic. Since this time, this railway bonus has been anchored in various guidelines and standards with a value of 5 dB(A) in Germany and other countries (see list prepared by Gottlob, 1994).

According to the statements in the Green Paper produced by the European Union in 1996, rail traffic has a larger part to play in the future. This means that high-speed traffic must be further developed, the utilisation of existing lines must be further improved and additional infrastructural measures will be required for rail traffic. The acoustic index for designating the nuisance effect will be the L_{aeq}, as the "EC index". Against this background, the question arises of whether the railway bonus as it is currently embodied in the legislation of many EU countries will continue to meet the demands of a fair noise protection policy.

Looking back at studies covering the railway bonus

The inspections of the literature carried out by Schuemer & Schuemer-Kohrs, 1991, Moehler & Schuemer-Kohrs, 1985, and Moehler, 1998, summarise the results of a number of international studies on the railway bonus. These studies all agree that the difference in nuisance depends on the level of noise, the period of time studied (day or night) and the observation period disturbed (e.g. communication, sleep):

- In the lower noise level range (approx. Lm = 50 to 60 dB(A)), the railway bonus seems to be less than in the higher noise level.
- During the day, the railway bonus of approx. 0-4 dB(A) is less than the night-time level of approx. 10 dB(A).

- With communication disturbances, the railway has a disadvantage of up to 4 dB(A), whilst there is a railway bonus of about 10 dB(A) when sleep is disturbed.

In the mean time, further field tests have been carried out in Austria by J. Lang, 1989, and in Japan by Yano et al., 1997, which have produced very different results; whilst the above railway bonus was confirmed in the Austrian study, there was no railway bonus in the Japanese study. However, it must be pointed out that both studies were not aimed at showing the different nuisance values of rail *and* road traffic noise; both were concerned basically with railway noise. The nuisance differences were quantified by the reanalysis of existing road studies.

Laboratory tests carried out by Fastl et al., 1994, 1996, showed a railway bonus of 5 dB(A). Finally, reference is also made to the theoretical studies by Windelberg, 1995, who rejects any nuisance differences between rail and road traffic noise for statistical reasons.

The discussions on assigning a railway bonus to the Transrapid attracted particular attention in the specialist world. Laboratory studies were carried out by Fastl & Gottschling, 1996, and Neugebauer & Ortscheid, 1996, and theoretical considerations were produced by Moehler & Liepert, 1996, and Höger & Felscher-Suhr, 1997; on the basis of these studies, a railway bonus of 5 dB(A) was finally laid down within the framework of a Decree for the Magnetic High-Speed Railway at speeds of up to 300 km/h.

All the studies carried out to date have aimed at determining whether there is actually a nuisance difference between road and rail traffic noise; the reasons for a railway bonus have not been examined in more detail until now. The acoustic reasons generally given for the railway bonus are the marked pause structure, the regular occurrence (timetable) of trains, dependence on tracks, etc.; possible non-acoustic reasons given are the more positive attitude to railways (environmentally friendly) and greater safety.

Effects of the application of the railway bonus in practice

In Germany, the railway bonus is applied, depending on the relevant regulations, for the building of new railway lines and the extension of existing ones. Reduction of the noise on existing lines is currently not possible for financial reasons. Three actual examples will be given to illustrate the different situations in which the railway bonus is applied.

Example 1: A local railway line with currently about 75 trains passing every 24 hours is expanded to 2 tracks; the train frequency is to be increased to 120 trains passing; by day, 4 trains/hour currently pass, which will increase in future to 6/hour; at night, 2 trains/hour pass, increasing to 3 in future.

Example 2: A heavily used long-distance railway line, with currently about 250 trains passing (passenger and goods trains) is to be expanded to 4 tracks; in future, there will be around 500 trains at speeds of max. 200 km/h. Since this is a long-distance traffic line with goods trains, there will be a passage frequency in the future, by day and night, of around 20 trains/hour.

Example 3: Parallel to a heavily used motorway, a 2-track high-speed line for long-distance passenger trains is to be built; the speed will be about 300 km/h; passage frequency by day will be yy trains/hour, and xx trains/hour by night.

The acoustic situation is very different in the three examples given:

- The pause structure of the railway noise is much more marked in example 1, with an average pause length of around 20 minutes, than in example 2, where the pauses are only 3 mins. In example 3, the pauses are longer than in example 3, but the pauses are filled by the noise of the motorway.

- The characteristic of the passage levels is the same in examples 1 and 3, since only one type of train uses these lines, whereas several different types of train use the track in example 2.

- The increases in level and also the level of the passage noise are clearly different in the examples given because of the different train material and the different speeds.

In all 3 examples, a uniform railway bonus of 5 dB(A) is given at present. Certainly, part of the difference in noise nuisance is taken into account by differences in category scales, but it is unarguable that many parameters that affect nuisance reactions, such as duration of pauses, passage frequency, other noises, etc. are not appropriately taken into consideration in the application of a single bonus figure.

Conclusions

The legislation in many countries gives a uniform value for the railway bonus of 5 dB(A). Both the results of studies on the effect of noise and the very different acoustic situations in practical examples indicate that the railway bonus should be differentiated, from the specialist point of view, in order to take the different acoustic situations into consideration.

On the basis of the present results of noise effect studies, the railway bonus could be different for the night and day; it is also worth considering whether there should be a railway bonus at all where usage is primarily for communication (e.g. schools, universities, parks).

It also seems that the railway bonus should be different for different acoustic situations. The first steps have been taken in this direction in Germany and Switzerland: in Germany, the railway bonus for the "Transrapid" magnetic high-speed railway was only approved up to a speed of 300 km/h; in Switzerland, a railway bonus of between 5 and 15 dB(A) is granted depending on the frequency with which trains pass.

As regards high-speed railway lines and the background noise levels created by other types of traffic, further differentiation seems necessary. A correction could be made for high-speed lines, for example, in consideration of shock reactions following the proposal made by Hanson in 1996.

Since it is also becoming increasingly necessary for environmental protection reasons to consolidate sources of traffic noise, so that the total noise situation becomes most important as the defining evaluation criterion, statements on the railway bonus depending on the background noise from other sound sources are particularly important.

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Noise emissions from local railway lines

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Summary

The principles for calculation in the "Guideline for Calculating Noise Emissions from Railway Lines - Noise 03", 1990 edition, were examined in terms of sound emissions from local railway lines by means of extensive measurements. In comparison with the existing calculation guideline Noise 03, the results indicate the need for differentiated statements as regards noise emissions.