inter·noise 2001

The Hague, Holland

The 2001 International Congress and Exhibition
on Noise Control Engineering
The Hague, The Netherlands, 2001 August 27-30

Cost-benefit calculation to prevent more than 65 dB(A) for railway noise in The Netherlands

Frank Elbers, dBvision, Vondellaan 6, NL- 3521 GD Utrecht, Tel: +31 6 29076161, Fax +31 10 4226519, E-mail: frank.elbers@dBvision.nl.

Abstract

Noise legislation for railways is enacted since 1987 in The Netherlands. This legislation prevents reception levels above 57 dB(A) for new situations, an increase of reception levels when reconstruction's are planned and a limited growth of noise creation. To reduce annoyance for high noise levels a large reduction program is part of this legislation. This program prevents 65 dB(A) levels near houses. To prevent these values two kind of measures are taken into account: noise barriers and window insulation. This article presents the results of a study that is sponsored by the Ministry of Housing, Spatial Planning and the Environment: a cost-benefit analysis to prevent noise reception levels above 65 dB(A). This analysis is done with four different scenarios of track and rolling stock combinations: 1. no source reduction, 2. replacement of wooden sleepers by concrete sleepers, 3. scenario 2 with additional rail dampers, 4. scenario 2 with a 7 dB(A) reduction of vehicles with cast iron thread brake.

1. Introduction

Noise control becomes a major economic factor for the Dutch legislators and railways since environmental legislation is being enacted in 1987. Limit values were chosen from an environmental point of view. Relative from now, not much was known about the cost and the environmental impact of the noise legislation.

The Dutch noise legislation distinguishes 4 situations:

1. Prevent reception levels above 57 dB(A) for new situations,
2. Prevent an increase of reception levels when reconstruction's are planned,
3. Prevent growth of noise creation above certain conditions.
4. Prevent future reception levels above 65 dB(A).

Nowadays large programs are carried out to prevent noise reception levels above 65 dB(A) near houses (situation 4). Noise control is done by window insulation of houses and placing noise barriers along railway lines. Studies in Switzerland, The Netherlands and Europe have shown that large cost for noise control can be saved by putting more effort in noise reduction of trains and track instead of the traditional means with barriers and window insulation. Therefore at present the Dutch noise control program will have attractive options for noise

reduction by barriers only. This article presents these options from a cost-benefit point of view.

2. Noise legislation and methodology

The Dutch noise legislation prevents noise reception values above 65 dB(A) near houses. The implementation of noise measures is done with 3 implementation programs:

1. Window insulation for situations where other measures are not effective.
2. Noise barriers for situations where reconstruction of an existing line is planned.
3. Noise barriers for situations where no reconstruction of an existing line is planned.

Window insulation

During the mid 90's local communities worked out a research program to find out situations with houses having:

1. a reception value above 65 dB(A) in 1987 and
2. where noise barriers are insufficient to prevent 65 dB(A) for future situations.

For this research program a special noise calculation program was developed with the planned future railway traffic flow (2005 – 2010) and infrastructure. The Ministry of Housing,

Spatial Planning and the Environment asked all local communities to fill this program with data from houses with above given criteria. To do this work efficient and on a uniform way, for the purpose of this project a special form on top of the noise calculation program was developed (Sandata). The result of this project is a list of houses where window insulation is the only effective measure to reduce annoyance due to noise reception values above 65 dB(A) by railway lines.

Reconstruction of existing lines

The Ministry of Transport planned nation wide many upgrades of the national railway network. The Dutch noise legislation forces the railways to:

1. Prevent an increase of the existing noise reception values and
2. Prevent future noise reception levels above 65 dB(A).

Measures to prevent future levels above 65 dB(A) are planned by the time the reconstruction of the railway line is done. This method is chosen to combine work and cost for both goals at the same time. From 1995 until the year 2015 the railways planned to upgrade about 420 km line.

Noise barriers along existing lines without a planned reconstruction

Noise barriers will be placed in a separate program, for railway lines where no upgrade is planned and that will not have houses where noise barriers are not effective to prevent 65 dB(A) for future situations. The Ministry of Housing, Spatial Planning and the Environment will finance these measures. Local communities in co-operation with the railways will do requests for finance based on additional detailed research. The research project described in this paper is done to estimate the budget needed for this implementation program. Estimates are calculated for four scenarios:

1. No source reduction on trains and track relative to the current situation.
2. Replacement of wooden sleepers by concrete sleepers and non-welded track by welded track (which will be done automatically within about 20 years).

3. Scenario 2 with additional rail dampers that will reduce about 5 dB(A) and that will only be placed on lines that needs additional measures for noise reduction.
4. Scenario 2 with a 7 dB(A) reduction of all Dutch passenger freight rolling stock of The Netherlands, Germany, Austria and Switzerland with cast iron thread brakes. The reduction can be achieved by replacement with for example disc brakes only.

Calculation of the noise measures is done with the software program Gerano98 [1, 2]. At present the noise reduction by rail dampers is estimated on 2 dB(A). With present knowledge calculated results will therefore overestimate noise reduction and underestimated the extent of additional barriers.

3. Results

Window insulation

In 1987 about 20.000 houses were within a situations where other measures than window insulation are no effective (see figure 1). Without additional noise measures about 16.000 houses still have a noise reception level above 65 dB(A) in the period 2005-2010. The cost for window insulation is estimated on about 100 million Euro. If noise barriers were applied to prevent levels above 65 dB(A) these cost would be about 240 million Euro. The program to install all these measures will run from 1997 to 2010. For about 4.000 houses the change in traffic flow will reduce the noise reception level below 66 dB(A).

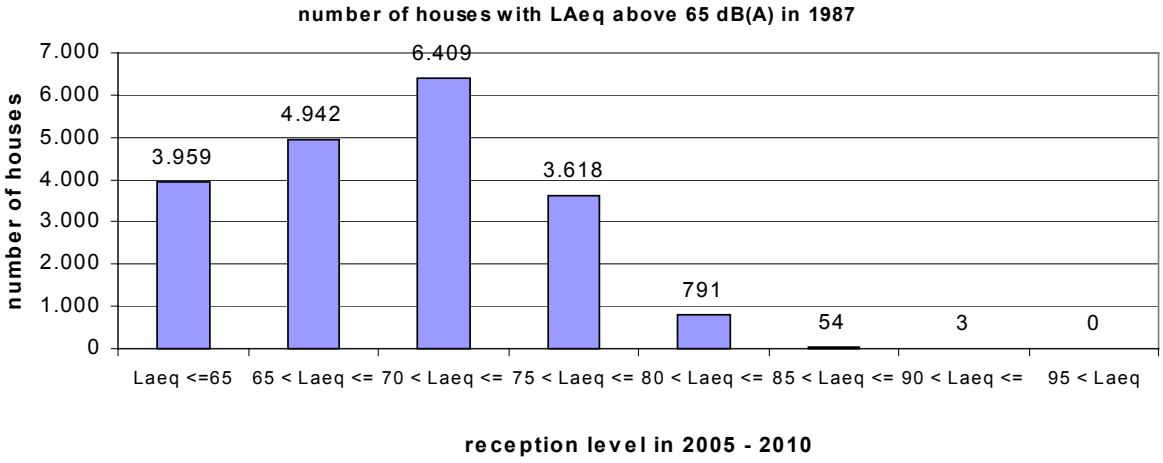

Figure 1: Number of houses with a equivalent noise level above 65 dB(A) in 1987 that needs to have window insulation when the future noise reception level is above 65 dB(A).

Reconstruction of existing lines

Since 1987 reconstruction of existing lines for about 420 km railway line is finished, in progress or planned. Within these reconstruction projects, railways have to place barriers for situations with reception levels above 65 dB(A). The cost for these barriers is estimated on about 80 million Euro. This is equal to about 0,2 million Euro per kilometre railway line.

When source reduction is applied these cost will reduce to 75 million Euro for scenario 2 as described in the previous paragraph below 'Noise barriers along existing lines without a planned reconstruction'. Scenario 3 (rail dampers) will reduce these costs to 70 million Euro. Large scale introduction low noise trains by replacement of tread brakes to (for example) disc

brakes (scenario 4) will reduce these costs to 40 million Euro. This is a 50 % reduction compared to scenario 1 were no source reduction measures are applied.

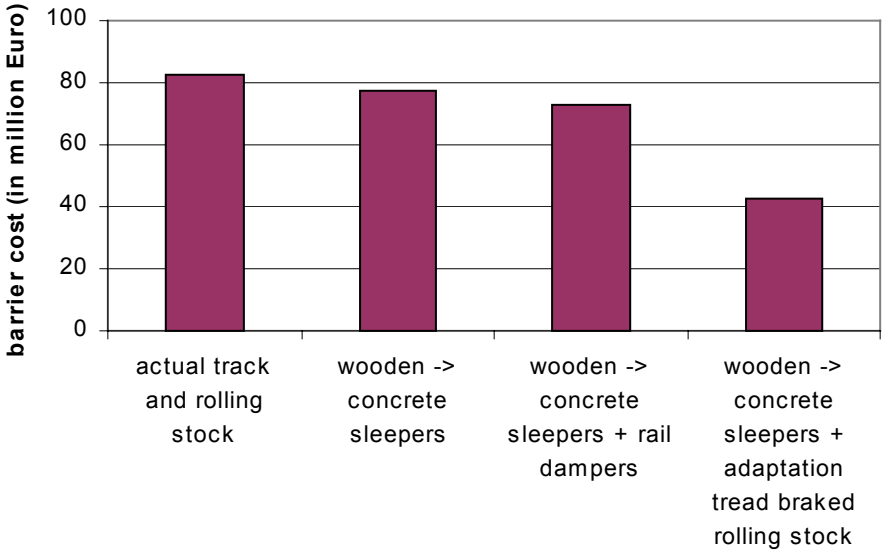

Figure 2: Length and cost of noise barriers to prevent reception levels above 65 dB(A) along existing lines without planned reconstruction.

Noise barriers along existing lines without a planned reconstruction

The Dutch railway network has a total length of about 3.000 km. The length of existing lines where no reconstruction is planned is about 1.500 to 1.600 km. The cost for noise barriers that will prevent noise reception levels above 65 dB(A) (for situations along this part were a barrier is an efficient measure) is 220 million Euro [3]. This is equal to about 0,1 million per kilometre. 84% of these barriers will have a height of 2 m above the track. The rest will have a height of 4 to 6 m (see figure 3).

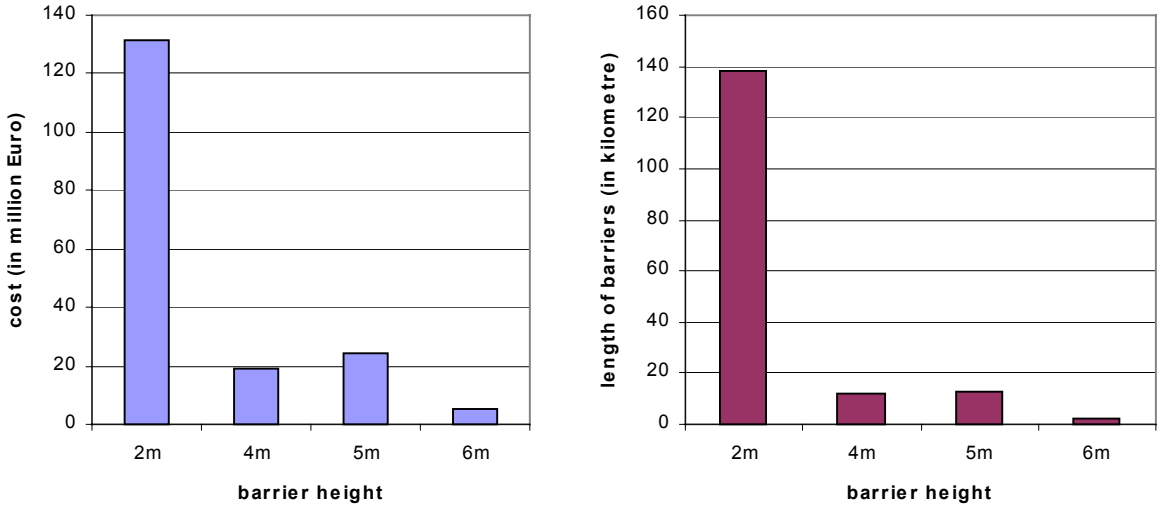

Figure 3: Length and cost of noise barriers to prevent reception levels above 65 dB(A) along existing lines without a planned reconstruction.

Source reduction will reduce the cost for barriers. For scenario 2 (replacement of wooden sleepers by concrete sleepers; -2 dB(A) reduction) the cost will be reduced to 190 million Euro. Scenario 3 (additional rail dampers instead of barriers) the cost for noise barriers will be reduced to 130 million Euro. Large scale introduction low noise trains by replacement of tread brakes to (for example) disc brakes (scenario 4) will reduce these costs to 95 million Euro. This is a 55 % reduction compared to scenario 1 were no source reduction measures are applied.

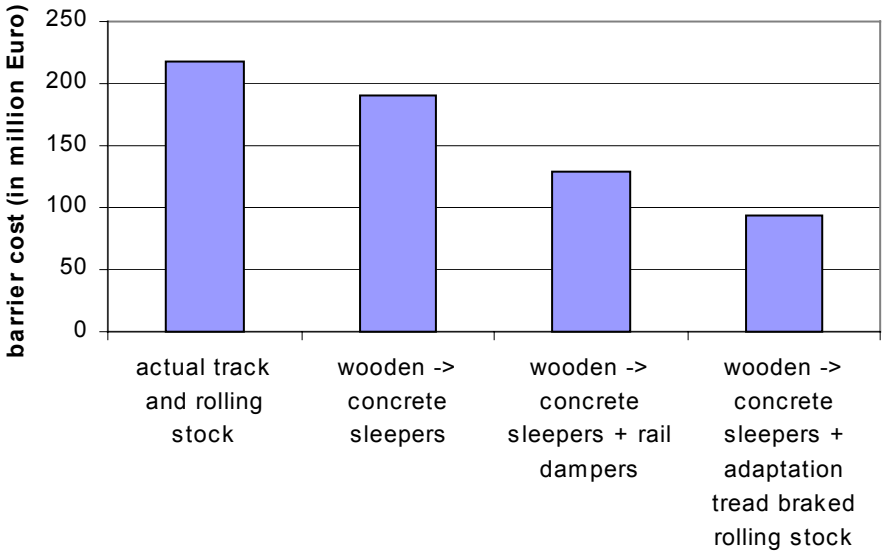

Figure 4: Cost of noise barriers to prevent reception levels above 65 dB(A) along existing lines without a planned reconstruction.

4. Conclusions

Dutch noise legislation for railway lines is enacted since 1987. This legislation will enforce measures to prevent situations with noise reception levels above 65 dB(A). Different studies estimate the total cost for measures on 400 million Euro. 25% of this cost is for window insulation and 75% is for noise barriers.

Actual developments were wooden sleepers are replaced by concrete sleepers will reduce the cost for noise barriers. The reduction is only less than 10%. The cost reduction is more when additional to this development, rail dampers are placed on lines that needs additional measures for noise reduction. The reduction will be about 30%. Cost for rail dampers is not calculated.

A large reduction of 55% can be achieved when legislation will be adapted with rules that enforce noise reduction from noisy trains (with cast iron tread brakes). This reduction will reduce the cost of barriers from 300 million Euro to 140 million Euro. The cost for noise reduction at those vehicles is about 450 million Euro [3, 4]. Additional savings will be achieved for noise measure along new lines to prevent reception levels above 57 dB(A) and along existing with a planned reconstruction to prevent an increase of noise reception values.

Acknowledgements

The author wishes to thank Dolf de Gruijter of the Ministry of Housing, Spatial Planning and the Environment for financing the study and providing information for this article. Also thanks to Paul van Wijngaarden of the Dutch railway Inframanagement for his support during the study. The author carried out the study during the time he was working for NS Technisch Onderzoek, the Technical Research department of the Dutch railways.

References

1. Elbers F.B.J., Handhaving en planning van geluid van grote verkeersnetwerken met Gerano, Geluid, December 1999.
2. Elbers F.B.J. and Oertli J., Eurano99: Policy tool for strategy of railway noise, Internoise2000, 27-30 August 2000.
3. Elbers F.B.J., and Bol S., Inventarisatie sanering railverkeerslawaai met schermen en stillere bruggen, NS Technisch Onderzoek, 2000.
4. Boer L. de and Beek A. van, Stille treinen in breed perspectief, KPMG and NS Technisch Onderzoek, 1999.