

Modelling and monitoring Dutch highway traffic noise production

Teun Veger

Rijkswaterstaat, Ministry of Infrastructure and the Environment, the Netherlands.

Anne Dijkstra

Rijkswaterstaat, Ministry of Infrastructure and the Environment, the Netherlands.

Renez Nota

Rijkswaterstaat, Ministry of Infrastructure and the Environment, the Netherlands.

Richard Jonker

Rijkswaterstaat, Ministry of Infrastructure and the Environment, the Netherlands.

Summary

In 2012, the Environmental Management Act, a new legislation on noise production of highways in the Netherlands, came into effect. This legislation stipulates how the Dutch national road authority, Rijkswaterstaat, should continuously monitor the noise production of highway traffic to check if it stays within the prescribed limits. Rijkswaterstaat has a statutory duty to keep the noise production of the road below the noise production ceiling. In the compliance report, Rijkswaterstaat checks whether the actual noise production remains below the ceiling level. Purpose of this monitoring system is to ensure the protection of citizens by controlling the increase of noise production and to prevent the road authority being faced with unexpected noise reducing measures.

The permitted noise production levels for highways are fixed in a public noise register. The noise register consists of about 60.000 reference points alongside the highways. These reference points are not physical points where noise is measured, but virtual points in a digital computational model. With this model a maximum permitted noise production level, the noise production limit, is calculated for each reference point. The noise production limit is different for each reference point. It is based on the local parameters determining noise production, such as traffic speed, traffic intensity, noise barriers and road surfaces in a reference situation (mostly the year 2008).

Each year Rijkswaterstaat has to publish a report about the compliance with the noise production limits. To determine the compliance, a database is created each year with information about noise production in the previous calendar year. Based on this database, the noise production in that calendar year is calculated and compared to the noise production limits in the noise register. When exceedance of the noise production limits is imminent, Rijkswaterstaat has to take action to reduce the noise production. This paper discusses the experiences acquired after implementing the Dutch noise legislation for highways. It focuses on the benefits and challenges that come with a nationwide computational model to monitor the compliance with noise production limits.

PACS no. 43.50.Lj, 43.50.RQ, 43.50.Sr, 43.50.Yw

1. Introduction

In 2012, new legislation on noise production of highways in the Netherlands, the Environmental Management Act, came into effect. The new legislation has three principles (see figure 1):

- 1) Controlling noise production
- 2) Reducing high noise levels on houses
- 3) Stimulation of noise source measures.

Each of these principles has its own legal instruments. In this paper we focus on the first principle, controlling noise production. This principle focuses on how the Dutch national road authority, Rijkswaterstaat, should continuously monitor whether the noise production of highway traffic stays within the limits. Purpose of this monitoring system is to ensure the protection of citizens by controlling the increase of noise production and to prevent the road authority being faced with unexpected noise reducing measures. The second principle, reducing high noise levels on houses, is put in a nationwide program. In this program almost 1 million houses will be investigated and noise reduction measures will be implemented if it's proven to be cost effective. When noise barriers or noise reducing pavements are not possible or not cost effective, houses will be isolated to guarantee the legal in house noise level.

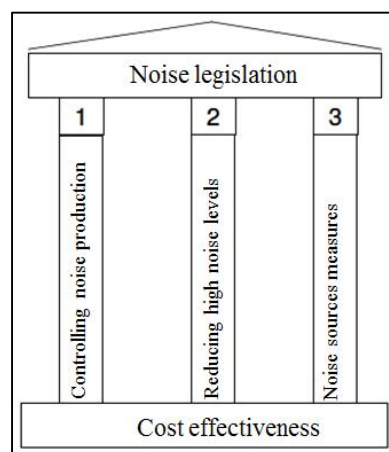


Figure 1. The structural elements of the Environmental Management Act.

The third principle, stimulation of noise source measures, is implemented through a standard pavement with a minimal acoustic quality (porous asphalt). Additionally, very porous asphalt can be implemented as an extra noise source measure when necessary. The Dutch national road authority Rijkswaterstaat is also investigating more porous asphalt and other noise source measures.

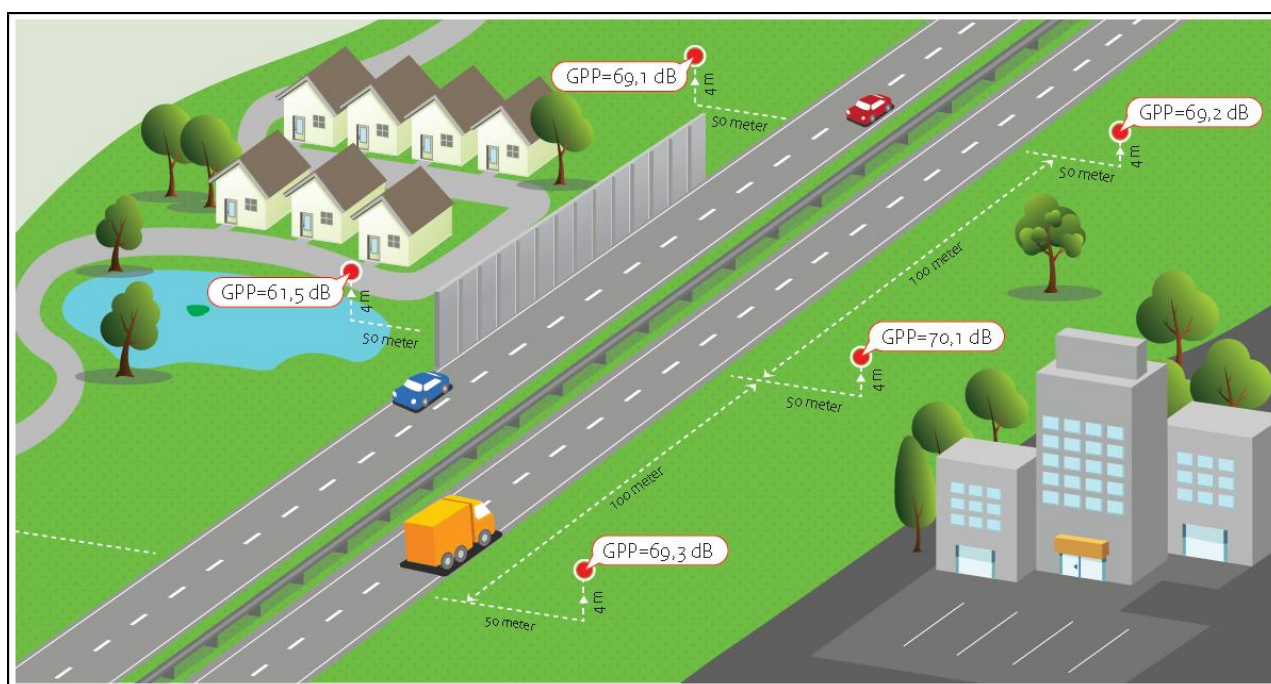


Figure 2. Noise limits in reference points.

2. Noise register

For the control of noise production, the permitted noise production levels for highways are fixed in a public noise register (www.rws.nl/geluidregister).

The noise register consists of about 60.000 reference points alongside the highways. The reference points are situated 50 meters away from the road, 100 meters apart and at 4 meters above local ground. These points are not physical points where noise is measured, but virtual points in a digital computational model. With this model a maximum permitted noise production level, the noise production limit (gpp) or noise production ceiling, is calculated for each reference point. The noise production limit is different for each point (see figure 2).

The production limit is calculated in L_{den} (dB) and is based on the local parameters determining noise production. This data (see figure 3) refers to data about a road at a particular moment, such as:

- amount of traffic;
- the type of road surface;
- the speed of the traffic;
- the position of noise barriers;
- the relative height of the road.

In the noise register, national roads are divided into two categories during the data input stage:

- Basic information: The level of the noise production ceilings along these roads is equal to the current production of noise, increased by 1.5 dB.
- Decision information: Noise production ceilings for these roads are based on source data derived from recent fixed decisions affecting these roads.

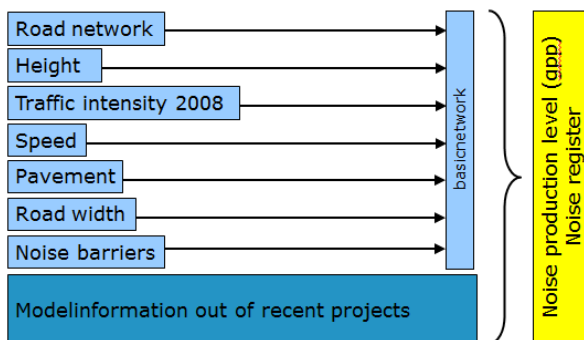


Figure 3. Input data.

The situation described above was fixed on 1 July 2012, the date of the entry that the new legislation came into force, and may only be altered by ministerial order. Rijkswaterstaat has a statutory duty to keep the noise production of the road below the noise production ceiling. In the compliance report, Rijkswaterstaat checks whether the actual noise production remains below the ceiling level. Consequently, no changes can be

made to the noise production ceiling levels without these being noticed.

2.1. Basic information

At the time the legislation was enacted, the greater part of the road network was referenced with source data dating from 2008. The legislation refers to this year as the ‘prevailing year’ and was used as the reference year. Using this source data the noise levels, measured in decibels, were calculated at the reference points. The outcome of this calculation is increased by 1.5 dB, the ceiling correction value, and this is the basis for the determination of the noise production ceiling.

In order to calculate the noise production and determine the noise production ceilings the following source data has been used for the roads:

1. Traffic data on the basis of calendar year 2008. If there was no data available then data from the calendar year closest to 2008 and from which data was available was used. This data was then corrected on the basis of yearly growth figures;
2. The situation as of 31 December 2008 determines which information concerning the position of road sections, the type of pavement and the position of shielding objects is entered into the register. When unavailable the most recent information prior to 1 July 2012ⁱⁱ, was used.
3. A ceiling correction value of 1.5 dB.

The information is based on available data as collected by Rijkswaterstaat.

2.2. Information concerning the calculation and forecasting process

For a number of locations in the past few years, the minister of Infrastructure and the Environment has made various decisions. An example from such a decision may involve the construction of a new road or major road works scheme. As these decisions always include a forecast of how noise production will develop over time, data from the ministerial decision rather than from the prevailing year are used for such locations. This forecast has been entered into the noise register. The outcome has not been increased by an additional ceiling correction value.

The noise production ceilings for projected or recently completed road sections have been calculated using the source data collected by the acoustic survey underlying the decision. Traffic data will be based on the prognosis that has been applied. Information about the type of pavement, shielding objects and speed will be taken directly

from the acoustic survey. These noise production ceilings are determined without applying the ceiling correction value.

Any local government body, such as a municipality, developing a building plan close to a national road will have to respect the protection level set by the noise register. That means that noise surveys must use data from the noise register when determining the noise level on the home. These calculations provide the basis for a decision whether to go ahead with the building plan, or if noise reducing pavements or the construction of noise barriers are needed.

3. Noise register

Rijkswaterstaat has the statutory duty to ensure that these noise production limits are observed. They carry out this obligation by annually reporting to the Minister about the compliance with the noise production limits. The report refers to the previous calendar year and includes information on how noise ceiling overruns are avoided.

Observing noise production ceilings may require the installation of noise reducing measures, such as noise reducing road surfaces or noise barriers. The work on these projects is combined as much as possible with other planned work ("half the work is in the planning"). The biggest challenge in observing and avoiding exceeding noise production ceilings is the planning of the required measures, their inclusion in the programming and their timely implementation.

Producing a compliance report includes the following steps:

1. Compiling the set of compliance data;
2. Calculating the noise production in 2013;
3. Comparing the noise production in 2013 with the noise production ceiling;
4. Analysing the remaining overhead capacity;
5. When the remaining overhead ≤ 0.5 dB and utilisation of the overhead remains under the ceiling before 2019: identify the next steps;
6. Record results into compliance report.

Annually, Rijkswaterstaat calculates the noise production from the previous year. The data used in this calculation is of the same sort used to determine the noise production ceiling. This means that all relevant source data is collected and brought together into a compliance data set. The chart below illustrates how this compliance data set is produced.

Traffic intensities obtained by counts and a traffic model are assigned to the source data of the noise

register, applicable on 31 December of the relevant calendar year. Subsequently, changes in road placement, road surfaces and traffic speeds are applied to this data set. At locations where road works are being carried out it is not possible to carry out calculations. In these cases an exemption from the obligation to comply is granted.

The chart in figure 4 represents the procedure to produce a compliance data set.

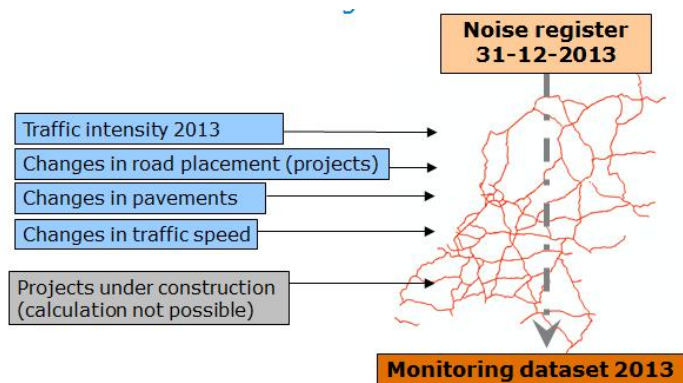


Figure 4. Producing a compliance data set.

This monitoring data set was used to calculate the noise levels in 2013 at every reference point included in the noise register. This calculation was performed with the same calculation model as used to determine the noise production ceilings in the noise register. The noise production in 2013 was then compared to the established noise production ceilings.

Next, a more detailed examination was carried out in three steps:

1. With regard to the situations where the noise production exceeded the noise production ceiling, the causes were examined. This resulted in a distinction between real overruns and situations where the overrun was caused by inaccuracies in the noise production ceiling or in the 2013 data.
2. In the case of real overruns, these are examined to see if they were resolved in 2014 or if expected developments will resolve them within the next five years.
3. For the remaining real overruns a study takes place to identify where the best solutions can be found. The law describes a cost-effectiveness criterion to weigh up the costs and the benefits of noise reducing measures. The installation of a noise reducing road surface or a noise barrier is effective when it benefits many homes. The law provides the possibility to raise the ceiling limit when noise reduction measures

are not cost-effective, for instance on locations with few homes.

3.1. Imminent overruns

On locations where an imminent overrun has been identified, a noise capacity overhead ≤ 0.5 dB, a study will take place to identify potential and necessary measures. In accordance with the law, the outcome of this study will be published in the next compliance report.

3.2. Solutions

Rijkswaterstaat works to solve and prevent overruns by:

- installing noise reducing road surfaces on locations where the presence of homes makes this cost-effective.
- installing noise barriers or increasing their height under particular conditions, and
- raising the noise production limits at locations where there are very few or no homes present, noise reducing measures are not necessary and noise insulation measures at houses will do to fulfill indoor noise limits.

These solutions require time respectively for their preparation as well as procedurally. Moreover, Rijkswaterstaat will combine, as much as is possible, the implementation of solutions together with major repairs and infrastructural projects. The combining of works is very efficient in preventing extra costs, increased procedural burden, traffic inconvenience and capital waste. However, the downside is the persistence of noise overruns for longer periods before a solution has been implemented.

4. Results of the first compliance report

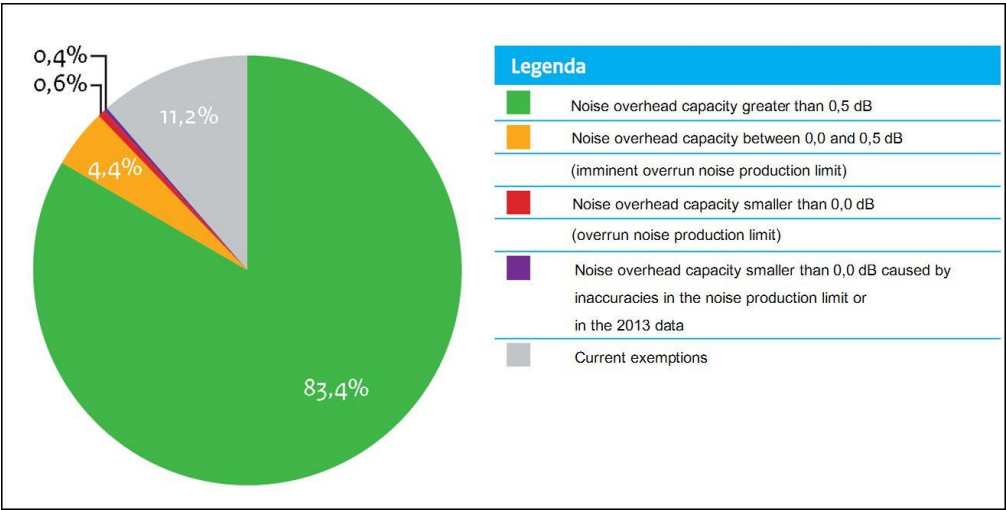


Figure 5. % Noise overhead capacity

In 2013, the national road network had 60.000 reference points. Figure 5 displays the noise overhead capacity, the difference between the noise production ceiling and the actual noise production, at the reference points. The conclusion is that the noise production as calculated for the year 2013 remains below the noise production ceiling in 99% of all cases, (59 176 reference points). The figure also includes current exemptions.

This outcome is further illustrated on the map in the compliance report which is reproduced below.



Figure 6. Compliance noise production limits 2013.

The first compliance report revealed a number of noise hot spots with (imminent) overrun of noise production limits. The Dutch law provides residents living along national roads protection against rising noise levels. In case the noise production exceeds the noise production limit, Rijkswaterstaat is required to carry out a study into mitigation measures. These measures are implemented when they are cost-effective.

5. Conclusions

Rijkswaterstaat has drawn up a public compliance report that is accessible to anyone via the Internet. The central message is that the systematic approach of the new legislation works, for the following reasons:

- Rijkswaterstaat will tackle locations situated outside of infrastructure projects where the noise has increased, under the old legislation this could have continued to increase uncontrollably.
- The compliance report identifies that the number of locations, where the noise production limit has been exceeded, is limited.
- All locations where limits have been exceeded, or there is a threat that they will exceed, have been identified in an open and transparent manner. Every step taken to counteract excessive noise levels is described; as well as ensuring that any current threats of excessive noise existing for road sections are removed.

With this report, and the associated related actions, Rijkswaterstaat provides the required clarification to the care-of-duty and compliance requirements in maintaining the noise production limits, as defined in the legislation.

References

- [1] Rijkswaterstaat: Nalevingsverslag geluidproductieplafonds rijkswegen 2013, Delft, 2014.
- [2] Rijkswaterstaat: Akoestisch onderzoek op referentiepunten, nalevingsverslag geluidproductieplafonds rijkswegen 2013, Delft, 2014.
- [3] Ministerie van Infrastructuur en Milieu: Nota van bevindingen nalevingsverslagen geluidproductieplafonds rijkswegen en spoorwegen in 2013, Den Haag, 2014.

ⁱⁱ the date the new law came into force