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NOISE ANNOYANCE RESEARCH AND ASSOCIATED LEGISLATIVE PROBLEMS IN THE NETHERLANDS

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Introduction

In 1975 a draft bill on noise was introduced in the Netherlands' parliament; in the spring of 1979 it was signed by Queen Juliana and thus became law.
It is expected that it will become effective within a few years, depending on the time necessary to complete the regulations for its implementation.
A major research program had been started in 1973 to get operational solutions for the many problems involved in noise reglementation.
In this paper a brief summary of the results of this program op to now is presented. For details one should study the many reports that have been published by the "Interdepartementale Commissie Geluidhinder" (ICG), the official committee that formulates the research programs and evaluates the results. Its members are civil servants of the various ministries involved in noise problems.

Main principles of the bill

The main aim of the bill is to safeguard a minimum acoustic quality of the living environment through

- a system of noise zoning around major sources of noise: roads, railroads, industrial areas;
- indentification and preservation of areas of quiet;
- enforcement of minimum sound insulation between dwellings;
- improvement of existing bad situations through rehabilitation programmes;
- type testing, labeling and/or noise certification of noisy appliances and machinery.

Noise zoning around airports is regulated through the air traffic law. The funds, necessary for the whole operation will be acquired through noise levies, posed upon the major noise producers: road vehicle operators, noisy industries etc.

The law deals with road traffic noise, railroad noise, industrial noise, recreational noise and domestic noise in different chapters. This is essential: not only do the dose-effect relationships differ because of the influence of non-acoustic factors on human response to noise but also are the technical, economical and political possibilities for noise control different for the various classes of noise. The research effort has been structured in accordance with these principles; seperate programs for road traffic noise, industrial noise, aircraft noise, railroad noise, domestic noise and noise sources. Care has been taken, however, that in both the regulations and the research programs common problems are dealt with, as far as practicable, in the same way. Thus one tries to use the same quantities and units, has joint projects for sound transmission studies and methods of measurement, etc.

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Main aims of the research projects

These can be summarized as follows: Provide the authorities with systems for noise assessment, noise measurement and noise prediction. Furthermore, evaluate various possibilities for noise abatement, as to their effectiveness and their financial consequences; make surveys of the "bad" acoustic situations with regard to traffic noise, aircraft noise, industrial noise and railroad noise, with indications about the possibilities and costs of rehabilitation schemes. In view of the complexity and diversity of the problems involved, a coordinating system was set up, under the aegis of ICG; this consists of ICG Sub-committees one for each noise field. Each research project has its own "escorting" committee, with members who represent the various parties concerned: gouvernment, industry, science etc. Many institutions take part in the research work: they range from small private consultant firms to large bodies like TNO (Netherlands Organization for Applied Scientific Research) and various universities.

Continuity and unification of procedures

It must be emphasized that noise abatement in the Netherlands did not start with the introduction of the new noise abatement bill: various regulations contained already acoustic requirements. For type testing of motor vehicles the ISO measurement method was prescribed; it was common use to assess noise from industrial sources with ISO/R1996; building regulations contained acoustic requirements based on the Netherlands Standard NEN 1070, etc. It was advisable to retain, as far as possible, in the new legal system the quantities, units and procedures from the older ones. This meant, however, that not always complete standardization of quantities, units and methods could be attained. But this cloud has its silver lining: The noise limits set by the authorities are a compromise between what is desirable from the point of view of environmental hygiene and what is technically and economically feasible. The limits will often be different for the various classes of noise. Using one and the same quantity to describe noise immission shows clearly any differences between the limits; one thus evokes discussions about their fairness. When one uses different quantities, comparison is difficult and these discussions are avoided.

Quantities and units used

For all noise immissions except aircraft noise, the A-weighted equivalent continuous sound pressure level $L_{A,eq}$, determined over a long period - a year -, is the basic quantity. Separate values are determined for the day (7 to 19h), the evening (19 to 23h), and the night (23 to 7h) periods; the highest value of (L_{day}, L_{ev} + 5), L_{night} + 10), called the 24-hour-value, is the rating value for zoning purposes. The reasons for choosing this system were:

1. $L_{A,eq}$ has been proven to be a descriptor that correlates rather good with human opinions and reactions;
2. $L_{A,eq}$ can be reliably measured or calculated;
3. $L_{A,eq}$ changes logically when the number of noise sources, or their strength changes;
4. There is no hard evidence that the compensation, built into some 24-hour rating quantities (e.g. L_{dn}) is indeed a realistic one. There is certainly no ground for compensation in cases where the immission and/or the noise sensitivity is restricted in time, such as night clubs, schools, etc.

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For aircraft noise the immission quantity developed by Kosten et al. has been retained. This was derived from the U.K. Noise and Number Index; it uses, however, the maximum A-weighted sound pressure level per flyover instead of the level in PNdB and it includes a "night penalty factor".

Some highlights of the research results op to now

1. On the basis of a careful analysis of the available literature on social survey results, speech communication disturbance etc. the following qualification of living conditions in built-up area has been given as a function of the magnitude of the noise immission caused by major noise sources

   24-hour rating value (B)
   ($L_{A,eq}$, outdoors) : qualification
   in dB(A)

40 or less	: excellent	60	: mediocre
50	: reasonable	70 or more	: bad

   Obviously, this does not apply to sounds coming from one's neighbour's radio or bagpipe! The noise abatement bill takes the value of 50 dB(A) as basis for the zoning system.
2. Studies on the effect of ambient noise on the vocal output and the preferred listening level of conversational speech showed that when ambient noise levels are greater than about 35 dB(A), both are influenced and some loss of listening comfort is caused. (fig. 1.) When the signal-to-noise ratio gets lower than about +10 dB some loss of intelligibility occurs in terms of number of correctly understood intervocalic consonants. Whether or not this is acceptable in real life depends heavily on other factors: teaching or conversation at home, hearing acuity and concentration of the listener, vocal strength, effort and articulation of the speaker, etc. It was demonstrated that people with some hearing handicap need about 7 dB more signal-to-noise ratio than others to obtain the same level of listening comfort.
3. Several large scale experimentswere carried out to measure people's reaction to an improvement of the sound insulation of their house against extraneous noise. In Dordrecht nearly 400 dwellings were treated; before and after the treatment the annoyance was measured; afterwards also the inhabitants' opinion on the non-acoustic aspects of the situation was ascertained. Some of the results were (fig.2)
   a) roughly speaking, a confirmation of the acoustic qualification given above: at 55 to 60 dB(A); 30% annoyed, 6% seriously
      at 70 to 75 dB(A); 79% annoyed, 44% seriously.
   b) people were generally satisfied with the overall effect of the treatment;
   c) at 70 to 75 dB(A), with an improved facade,: 39% annoyed, 11% seriously.
   d) one was less satisfied with other aspects; such as ventilation, possibilities of cleaning, draught.

   A similar experiment in the case of aircraft noise yielded similar results: it moreover confirmed that the "dose-response" curve of the Schiphol aircraft noise enquiry in 1963 is still valid.
4. Social surveys around several military airbases brought to light that each airbase has more or less its own dose-response curve. There are sociological differences between the situations; this might very well be the cause.

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5. The projects on road traffic noise yielded reliable data on the acoustic strength of vehicles, belonging to different classes: private cars, lorries motorcycles. It was shown that retrofitting busses is feasible, from both a technical and a financial viewpoint; one major problem was the cooling system. Noise measurements on stationary road vehicles to monitor the effectiveness of the exhaust silencing system turned out to be completely unpracticable, for use by the police as well as for use in testing stations during periodic sefety checks of vehicles. However, a visual cheek, supplemented by listening to the sound, can be a very effective way to identify noisy vehicles. A preliminary check confirmed the main trends of the CCMC's work on urban driving conditions.
6. One consequence of choosing the long-term value of $L_{A,eq}$ as basic quantity is the necessity of having a reliable, operational measuring method. This means studying carefully the influence of atmosferic conditions on ground-to-ground sound transmission, and deriving from the data obtained a set of meteorological conditions - a so-called meteo-window -. Fig. 3 shows some results, obtained from several hundreds of measurements at two sites from a busy main road near Delft. One sees that only under downwind conditions, with a wind speed of a least 2 m/s, an acceptably small range of data is obtained. The values then found are some dB higher than the longterm value of $L_{A,eq}$. This can be compensated for by subtracting a "meteo correction term". Its value depends on source-to-receiver distance, source and receiver height and the local distribution of the wind direction; the normal range is 2 to 7 dB(A), but depends somewhat on the spectrum. Using this procedure for measurements implies that calculations should follow the same rule; calculate for downwind conditions and adjust to average conditions.

Conclusion

The research programs have yielded much information which is useful for the authorities involved in noise regulations. Inevitably, sometimes one finds that reality is more complicated than one had expected. Then a compromise has to be found: a simple rule might work but causes mistakes; whereas an intricate one may be perfect but does not function. One major problem in the field of noise abatement cannot be solved by science: that is how to devide the total necessary noise reduction between the parties who should contribute their share, but who are, understandably, eager to minimize that. In the case of traffic noise, e.g., a total noise reduction by 20 dB(A) would be adequate to really minimize the annoyance. Reduction at source, less noisy operation, better land use and town planning and improved housing design could each contribute 5 dB(A), but certainly no 20 dB(A). When the community would face the problem in this harmonious way much headway could be made.

ICG publications can be ordered from:
Ministerie van Volksgezondheid en Milieuhygiëne
Postbus 439
2260 AK LEIDSCHENDAM

At the same adress lists of available publications can be obtained.

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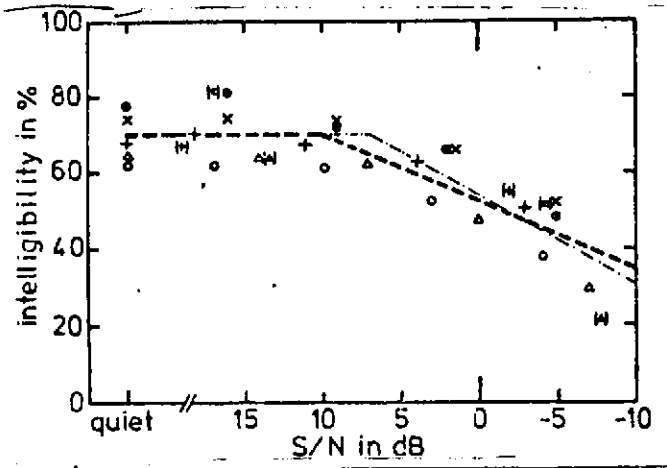


Fig. 1 Intelligibility of intervocalic consonents as a function of the signal-to noise ratio (from ICG publication VL-DR-18-02), Pols, van Heusden, plomp)

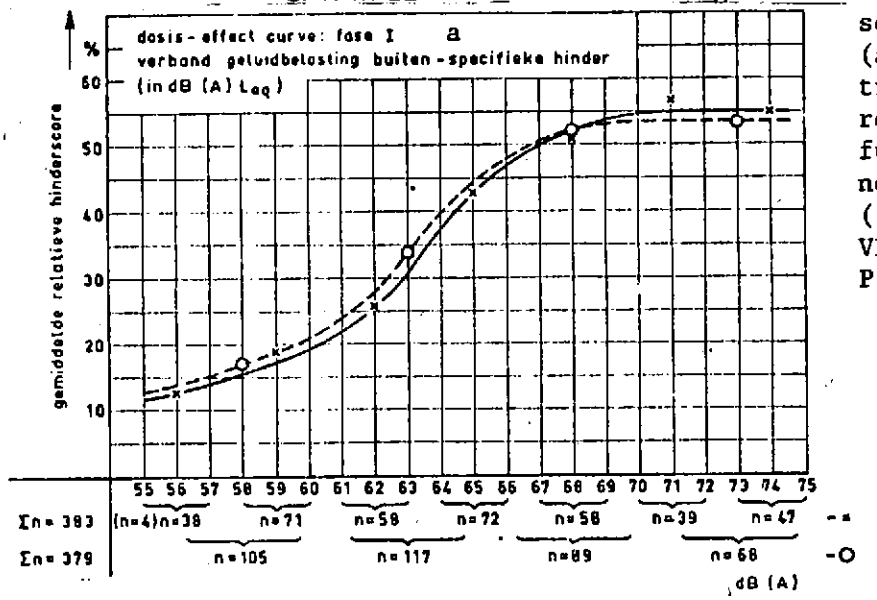
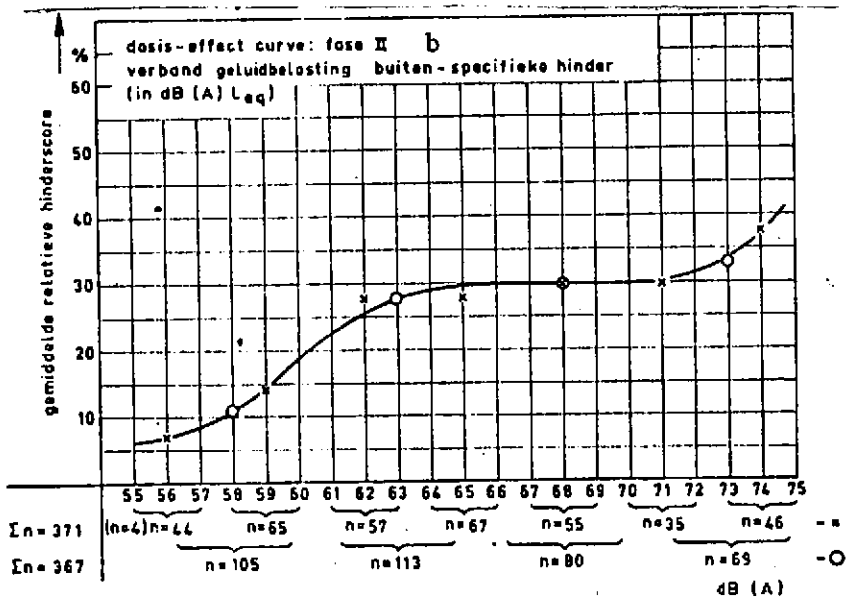


Fig. 2 Average relative annoyance score measured in Dordrecht, (a) before and (b) after treatment of houses against road traffic noise, as a function of the outside noise immission value. (from ICG publication VL-DR-14-01, Bitter, Kaper, Pinkse)



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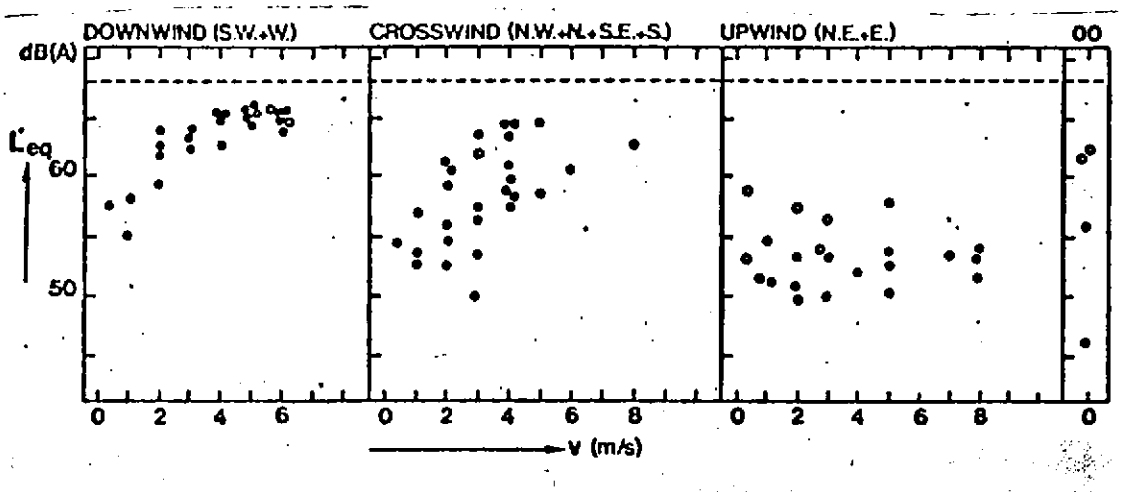

Fig. 3 Noise immission values at 200 m from a road, 1.8 m above ground, as a function of wind speed and direction.
(coming ICG publication, Moerkerken, van Wijk)