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NOISE IMPACT FROM HIGH SPEED TRAINS

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Introduction

In view of the plans of the Dutch Government to join up with the French railroad network for high speed trains, an investigation is being made into the anticipated impact on the environment.
One of the major aspects concerned is the possible noise nuisance. To assess the noise level that a passing train will produce, it is necessary to have accurate knowledge of the noise generated by the train concerned. However, as the rolling stock that will be operated in the Netherlands still has to be built, nothing is yet known about the aspect. Therefore a number of assumptions have been agreed upon, on which the necessary forecasts can be based.

1. Computer calculations will be based on the "Regulations for the computation and measurement of noise from rail traffic" issued by the Ministry of Housing, Physical Planning and the Environment in 1987, in connection with the Noise Nuisance Act.
2. To establish the "noise propagation figure" that must serve as input data when working with these computation regulations, use is made of the information provided to the Dutch Railways by the Deutsche Bundesbahn and the Société Nationale des Chemins de Fer Français.

CRITERIA

a. High speeds will not be permitted where the high speed train runs on existing tracks (on which other trains also run). It is therefore assumed that the inclusion of high speed trains in the existing rail traffic intensity will not result in alteration of the acoustic situation.
b. To calculate the noise levels resulting from the high speed trains, use will be made of both the "Standard calculation method I" (calculation in dB(A) only) and the "Standard calculation method II" (calculation in both eight-octave bands and in dB(A)), as given in the above mentioned regulations.
c. The noise level, at 25 m away from the railway track, of a passing train consisting of two traction units and ten passenger coaches (238 m total length) is:

300 km/h : Laeq - 25 m = 95 dB(A)
200 km/h : Laeq - 25 m = 90 dB(A)
160 km/h : Laeq - 25 m = 87 dB(A)
The A-weighted range to be covered, converted to 0 dB(A) is:

63	125	250	500	1000	2000	4000	8000	Hz
-28	-26	-25	-17	-7	-3	-6	-24	dB

d. For the calculations, the above values are taken to apply to an observation point at an elevation of 3 m above grassland, and to a railway track laid on a dike 1 m above the grassland.

NOISE PROPAGATION FIGURES

a. Standard calculation method - I
The "noise propagation figure" in dB(A) of a rail section is determined with the equation

$$E = 10\lg \sum_{j=1}^{n} 10^{Ej/10} \quad dB(A) \qquad 1)$$

Here Ej is the emission term for the section concerned, for a specific type of train. The term is expressed by the equation

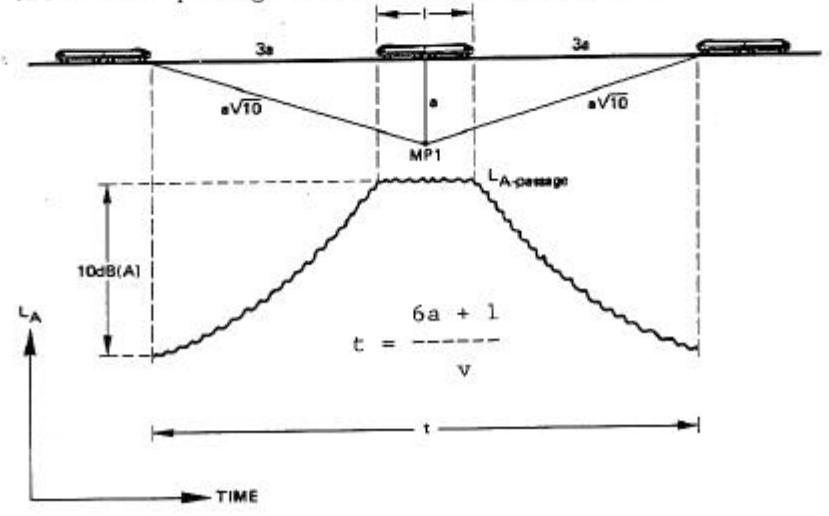
$$E_j = x + y\lg v + 10\lg Q \qquad 2)$$

Where:
x = constant dependent on the type of train
y = constant dependent on the type of train
v = velocity km/h
Q = average intensity per hour (number of railcars times number of trains)

The noise level at a distance of 25 m from the railway track was determined from the available data with:

$$Laeq\text{-}car = Laeq\text{-}passage + 10\lg t/3600 + 10\lg 1/12 \ dB(A) \qquad 3)$$

Where t is the time in seconds between the moments when the noise level of an approaching train and that of a receding train is 10 dB(A) lower than that of the noise level during the trains passage of the observation point.



4)

Taking into account the total damping factors for distance, air, soil and meteorological conditions of 15.2 dB(A) for passenger trains at a distance of 25 m, as established by standard calculation method I, the following propagation terms have been determined:

300 km/h : $E_j = 95 - 28.9 - 10.8 + 15.2 = 70.5$ dB(A)

200 km/h : $E_j = 90 - 27.1 - 10.8 + 15.2 = 67.3$ dB(A)

160 km/h : $E_j = 87 - 26.2 - 10.8 + 15.2 = 65.2$ dB(A)

These values are well expressed if equation 2 is completed as follows.

$$E_j = 21 + 20\lg v + 10\lg Q \quad \text{dB(A)} \qquad 5)$$

b. Standard calculation method II
In this method, the propagation figure per octave band is given by:

$$L_{e,i}^{bs} = 10\lg \sum_{c=1}^{3} 10^{(Ei,c\,-\,1)/10} + \sum_{c=4}^{5} 10^{(Ei,c\,-\,3)/10}\ \text{dB} \qquad 6)$$

and

$$L_{e,i}^{as} = 10\lg \sum_{c=1}^{3} 10^{(Ei,c\,-\,7)/10} + \sum_{c=4}^{5} 10^{(Ei,c\,-\,3)/10}\ \text{dB} \qquad 7)$$

Where $E_{i,c}$ the propagation term per train for a specific section. This term is expressed in general by the equation.

$$E_i = \alpha_i + \beta_i \lg v/60 + 10\lg Q/v \text{ dB} \qquad 8)$$

Where:
α = constant per octave band (dB)
β = constant per octave band
v = velocity (km/h)
Q = average intensity (numbers of cars times number of trains)

The propagation figure used as criteria for a distance from the rails of 25 m are well calculated if equation 8) is completed as follows:

1. 63 Hz : $E_i = 85 + 20\lg v/60 + 10\lg Q/v$ dB 9a)

2. 125 Hz : $E_i = 101 + 10\lg v/60 + 10\lg Q/v$ dB 9b)

3. 250 Hz : $E_i = 107 + 10\lg v/60 + 10\lg Q/v$ dB 9c)

4. 500 Hz : $E_i = 112 + 10\lg v/60 + 10\lg Q/v$ dB 9d)

5. 1000 Hz : $E_i = 113 + 20\lg v/60 + 10\lg Q/v$ dB 9e)

6. 2000 Hz : $E_i = 109 + 30\lg v/60 + 10\lg Q/v$ dB 9f)

7. 4000 Hz : $E_i = 107 + 30\lg v/60 + 10\lg Q/v$ dB 9g)

8. 8000 Hz : $E_i = 90 + 30\lg v/60 + 10\lg Q/v$ dB 9h)

CONCLUSION

The foregoing is based on very limited data. However, there are indications that the question of noise propagation by a high speed train can be expressed by the same computation method used in the Netherlands for other trains. DHV Consultants Ltd. believes that the method described is applicable in the framework of the Environment Impact Statement for high speed trains.

AREAS FOR SPECIAL ATTENTION

A number of noise measurements have been carried out to establish at what distance from the relevant rail sections the acoustic affect of a high speed train may be of importance. Where it can be expected that high speeds will occur, the L_{95} of the ambient noise has been measured. It appeared that a number of places along the projected rail sections there was an L_{95} of approximately 30 dB(A). The assumption made is that, for the current stage of the Environmental Impact Statement, attention must be given to a zone on both sides of the railway track bordered by the line at which the noise level at passage of the train is 30 dB(A). This means zones of land of approximately 3000 m wide for a train speed of 300 km per hour. A number of the components found within these zones have been inventoried, including:

a. Potential and existing nature sanctuaries.
b. Relevant noise sources with a noise zone in connection with the Noise Nuisance Act.
   - roads with a traffic intensity of more than 2450 motor vehicles per 24 hours
   - existing railway lines
   - airfields
   - industrial sites.
c. Number of houses and residents.
d. Number of other buildings sensitive to noise, as designated in the Noise Nuisance Act.
   - schools
   - hospitals
   - nursing homes
   - day clinics.

FURTHER ACTIVITIES

In accordance with the areas for special attention mentioned and the related inventories carried out, the noise levels which will have a relevant environmental effect within the zones are being established.
Special consideration is given to the cumulative effect of the noise nuisance already experienced in the zones with that of the HST's.
The degree to which noise nuisance or its increase is experienced is assessed with the aid of a method for estimating the cumulative arrogance of noises, developed by TNO Institute of Preventive Health Care as a commission from the Ministry of Housing, Physical Planning and the Environment.