inter·noise 96
25th Anniversary Congress – Liverpool

INCE: 52.3

TECHNICAL IMPLICATIONS OF THE NEW FRENCH REGULATIONS IN THE FIELD OF TRAFFIC NOISE

D Soulage (1) & F Besnard (2)

(1) Centre d'Études sur les Réseaux, les Transports, l' Urbanisme et les constructions publiques (CERTU), France, (2) Service d'Études Techniques des Routes et Autoroutes (SETRA), France

1. THE CONTENT OF THE NEW FRENCH REGULATIONS

The new regulations in France in the field of traffic noise [1] settle more severe requirements and bring many other significant changes. One of the main changes is that the periods for determining the L_{Aeq} levels have changed into 6am-10pm and 10pm-6am, and that the calculation of night-time noise is now mandatory.

Construction of new roads

The maximum levels have been lowered, and defined separately for each kind of premises. The new limits for roads are shown in Table 1. Note that in French practice, these levels are considered 2 meters in front of the façade with shut windows, and therefore include a + 3 dB(A) correction for the reflection on the façade.

KIND OF PREMISES	L_{Aeq} (6am-10pm)	L_{Aeq} (10pm-6am)
Health and social welfare establishments:		
- care rooms and rest rooms	57 dB(A)	55 dB(A)
- other rooms	60 dB(A)	55 dB(A)
Teaching establishments (except noisy workshops and sport halls)	60 dB(A)	-
Dwellings in moderate noise climate zone	60 dB(A)	55 dB(A)
Other dwellings	65 dB(A)	60 dB(A)
Offices in moderate noise climate zone	65 dB(A)	-

Table 1: Maximum accepted sound levels for new roads.

The prediction assessment must take into account the real long-term meteorological conditions (wind and temperature gradient) existing *in situ*, and their influence on noise propagation, when the receiver points are located further than 250 meters from the road. The final result can not be lower than the result with hypothesis of homogeneous

atmosphere. This corresponds to a strong demand from the general public. This requirement has large consequences [2]. German and Dutch regulations lean on conventional downwind propagation conditions, when ours consider the real meteorological conditions of the site.

The regulations underline the interest of noise level measurements once the road is opened to traffic. Though they are not mandatory, it is obvious that the general public will ask for more checking measurements: this is the only way for the French public opinion to trust into results.

Construction of buildings along noisy roads

All the roads will be classified in five classes according to their noise emission. Town planning documents will have to be modified within the delay of two years in order to take into account the areas affected by noise disturbance and to define special noise insulation criteria for the new buildings. The classification of the roads will be generally calculated from the noise levels close to the roads: a calculation method, based on [3], has been recently standardised [4]. This quite simple method can also be used to make global diagnosis of noise emitted by roads in towns.

When both road and building exist

The first regulation existing in France about noise control is from 1978. We have now a great number of situations where buildings have been constructed along roads before this date without any particular protection against noise. This represents 182 000 apartments. A general program for protecting all these buildings is now under study, for a total cost of approximately 9 thousand million Francs.

2. THE NEW CALCULATION METHOD INCLUDING METEOROLOGICAL EFFECTS

Context

No calculation method including meteorological effects existed in France at the time when the new regulations appeared. The only existing method was the ISO 9613-2 standard, but the studies carried out in France about this document showed that it was not directly usable for dealing with the problem of traffic noise calculations in accordance with our regulations. The main defaults founded out in this method are:

- the ISO standard is well adapted to point sources, but it is less convenient when used with line sources;
- the ground effect is essentially calculated for flat sites;
- road cuttings and embankments are not taken into account;
- the method calculates noise levels in downwind conditions, and the long term level is estimated with a simple formula, which leads to a high uncertainty on the final result;
- the ISO standard does not permit to calculate a noise level in homogeneous meteorological conditions, but we need to evaluate this level in accordance to our regulation.

This is why CERTU, CSTB, LCPC and SETRA designed a new method [5] based on the principles described in the ISO standard, but improving and complementing it.

This new method calculates, for each acoustical path:

- the level corresponding to favourable meteorological conditions, L_F, computed with the method based on ISO, with the main improvements as follows:- non-flat grounds are simulated by an average ground calculated with a regression method;
  - image source and receiver are directly taken into account in the diffraction formula;
  - in case of diffraction, the curved path is specifically taken into account with a height correction, reproducing the difference between rectilinear and curved paths.
- the level corresponding to homogeneous conditions, L_H, with formulas similar to those used in the ISO standard, but adapted from theoretical models to a rectilinear path;
- the long-term level, using the following formula:

$$L_{LT} = 10 \lg\left(p.10^{0.1 L_F} + (1-p).10^{0.1 L_H}\right)$$

where p represents the ratio between the time during which favourable meteorological conditions occur and the overall observation time. This formula supposes that when the conditions are not favourable, the noise level is the level in homogeneous conditions. This choice is quite different from the ISO standard in which it is supposed that the noise levels are neglectible far from the source when the meteorological conditions are homogeneous or unfavourable.

The p factor is given in special maps for all the directions of propagation. This method has been validated [2, 6].

3. OTHER TECHNICAL IMPLICATIONS

Noise emission hypothesis

Noise emission values for single vehicles. These values are defined in [3], taking into account light vehicles, heavy vehicles, speed, road slope, and driving conditions. It seems now to be necessary to bring up to date these reference values, mainly due to the evolution of the vehicles during the past fifteen years, to the effect of road surfaces, and to improve the accuracy of the prediction of noise emitted by urban traffics. A general research program is now in progress.

Traffic values. The new obligation to predict night-time levels (10pm-6am) requires to be able to forecast corresponding traffics with sufficient accuracy, especially for heavy vehicles (HVs). On the most trafficked inter-urban motorways, a proportion of 50 % of HVs among the total traffic is usual during night time, and leads to a day-night difference between emission levels not higher than 3 dB(A). It is due to three combined factors: the new economical behaviours appeared during the

last 15 years (the "just-on-time" practice), the geographic location of France which links northern and southern Europe, and free night crossing by HVs (on the contrary of Switzerland and Austria, where it is forbidden).

In order to achieve a better accuracy on night-time traffic predictions, we are studying a sample of 200 traffic counters and deducing prediction formulas according to the annual average daily traffic and the road function.

Noise calculations accuracy

As the road works will be controlled with *in situ* measurements, our noise methods and softwares have to be as accurate as possible, and we have to know this accuracy. A general research program has begun on this subject, and two drafts of AFNOR standards are now available [7]:

- The Pr S 31-131 draft is about noise prediction softwares and defines the informations about the software content that a seller must provide to its customer. This is meant for preventing customers from buying a software that is not adapted to their needs.
- The other Pr S 31-132 draft is designed to define classes of noise prediction method, according to their accuracy, in the same way as we have sound meter classes.

These standards will be soon published.

Control measurements

The French official method for measuring road traffic noise is the NF S 31-085 standard [7]. However the present version advises to operate in "slightly favourable" propagation conditions (overcast sky and slight downwind) in order to allow a better reproducibility.

Our need is now completely different, since we have to estimate a long-term noise level (i.e. the mean level of a very long period, e.g. one year). The working group in charge of proposals for the review of the standard has first to answer a difficult question: how could one approximate this long-term level with only a one-day measurement of noise levels and meteorological conditions? To answer as best as possible, we need a better knowledge of the statistical distribution of noise levels according to time, topography and meteorological conditions, which will demand heavy investigations.

References

[1] Loi 92-1444 du 31/12/92, Décrets 95-21 et 95-22 du 9/01/95, Arrêté du 5/05/95
[2] V. Zouboff, "Representativity of long range sound level calculation" (Internoise 96)
[3] Guide du Bruit des Transports Terrestres, CERTU, 1980
[4] Note technique relative aux méthodes de calcul à utiliser pour le classement des infrastructures de transports terrestres, CERTU-SETRA, 1996
[5] Bruit des infrastructures routières - Méthode de calcul incluant les effets météorologiques, CERTU-CSTB-LCPC-SETRA, 1996
[6] Y. Gabillet, "Comparison of two methods for predicting traffic noise" (Internoise 96)
[7] AFNOR, NF S 31-085 "Caractérisation et mesurage du bruit dû au trafic routier", Pr S 31-131 "Descriptif technique des logiciels de prévision du bruit des transports terrestres", Pr S 31-132 "Classification des méthodes de prévision du bruit des infrastructures de transports terrestres"