NOISE & PLANNING '96

The 1996 International Congress on
"Acoustics applied to planning: from technical standards to environmental standards"

Pisa, Italy
May 28-31, 1996

ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES REGARDING TRAFFIC NOISE IN PORTUGAL

A. P. Oliveira Carvalho (1)
Cecília A. A. C. Rocha (2)

(1) Ph.D., Professor and Director Acoustical Laboratory, Faculty of Engineering, Univ. Porto, Portugal, tel./fax: 351.22508940, email: carvalho@fe.up.pt
(2) Civil Engineer, J.A.E. Technical Consultant, R. Camões , 219 - 4º, 4050 Porto, Portugal

ABSTRACT

Few years after the beginning of the use of Environmental Impact Assessment (EIA) studies regarding traffic noise in Portugal it is time to analyze the accomplishment of these environmental policies and the way these studies have been done.

The purpose of this paper is to present the preliminary results concerning a research project about noise in Environmental Impact Assessment. The scope of this research is to investigate and characterize methods of analysis regarding noise in the assessment of environmental impact and their influence in the built surrounding due to the construction of new roads and highways.

The goal is to study the methodologies of EIA studies that have been used in Portugal and eventually to adapt them to the Portuguese legal particularities that this subject implies in the particular area of noise.

This paper presents the main methods that have been used throughout Portugal, achieved by the analysis of the main EIA studies done in the near past. The methodologies presented result from the analysis made to the studies requested by the National Road Services - Ministry of Equipment, Planning and Territorial Administration (*JAE-MEPAT*) and the Portuguese Highway Central Authority (*BRISA*).

In summary, this project intends finally to systematize the major practices used in Portugal and eventually to propose a new and consistent Environmental Impact Assessment methodology to assess traffic noise in new roads or highways.

1. GOALS OF RESEARCH

The main goal of this paper is the analysis of the Portuguese situation and practice in Environmental Impact Assessment (EIA) studies, regarding traffic noise.

To fulfill this objective an intensive and global analysis of the EIA studies, ordered by the National Road Services from the Ministry of Equipment, Planning and Territorial Administration in Portugal (*JAE - MEPAT*), was done.

It was found that the environmental design teams are using four methodologies to perform this analysis. In the following chapters these different methods are presented, explained and compared.

2. SAMPLE USED

This paper is based on the analysis of EIA studies ordered by the National Road Services (*JAE-MEPAT)*, since 1991. The examination of those studies lead the authors to the noise consultant teams which were personally contacted to explain the options they have been making during the execution of their work and the individual characteristics of the methodology used. The analysis of these EIA studies resulted in the identification of four methods, each of them corresponding to a specific consultant team.

3. LEGISLATION

Portugal began establishing legislation in environmental areas, specially since its entrance in the Economic European Community (EEC) in June 1986.

The first law to appear was in April 1987 the National Environmental Policy Act *(Decreto-Lei nº 11/87-7.04.87 - Lei de Bases do Ambiente*), where several areas of environmental interest were defined and limits for some parameters were given in many of those areas.

In June 1987 and filling the gap related to noise, the Portuguese General Noise Code *(Decreto-Lei nº 251/87-24.06.87 - Regulamento Geral sobre o Ruído)* was published. It sets the minimum acoustical requirements to be achieved by different kind of activities, defines the Noise Zoning regarding different types of land use and rules the main noise-producing activities and traffic. This code was later modified in 1989 and 1992, specially concerning Noise Zoning Classification and Occupational Noise Safety.

In 1990 the European Directive no. 85/337/CEE-27.06.1985 was transposed to the Portuguese legislation by the D.L. no. 186/90 dated 6 June 1990, where different types of projects, in which EIA studies are a necessity, are listed. Related with this law, it was approved the D.R. no. 38/90-27.11.1990, regulating the form and content of the EIA studies for each of the major environmental areas.

A new Environmental Policy Act and a modified General Noise Code are now under study. In this future version of the Portuguese General Noise Code, the main modifications are:

- The acoustical parameter used to define and quantify the environmental noise is planned to be L_{Aeq}, replacing the L_{50}. However, the numerical limits to the Noise Zoning for different land uses, previously defined using the L_{50}, do not suffer any change.
- Concerning the Annoyance Rating Level, the future Noise Code plans to set more restrictive limits to the difference between the L_{Aeq} (equivalent continuous sound level) of the nuisance source and the L_{Aeq} of the background noise (without the nuisance source). The daytime limit (7:00 a.m. to 10:00 p.m.) for this difference is planned to be set in 5 dB(A) and the nighttime limit is going to be 3 dB(A) (10:00 p.m. to 7:00 a.m.).

In Portugal there is not any normalized methodology on environmental noise measurements to be followed by the field teams, concerning how to choose the places or specific locations where acoustical measurements should be done, their duration and the procedures on site, and other technical matters, to guarantee the possibility of comparison results among different consultant groups.

To have some technical support on their field measurements, these working teams use the Portuguese standard *NP-1730/1981*, although not exactly directed to this subject, but where some technical indications can be found. This standard is now under revision, which intends to adapt it to the actual knowledge and legislation on this matter. The international standard *ISO-1996* is now under study by the Portuguese Standards Committee on Acoustics (*CT-28*) to convert it to a Portuguese *NP* standard.

4. METHODOLOGIES OF EIA

4.1. Analysis Methods

The Table 1 presents a summary of the four methodologies used in Portugal in the EIA studies regarding traffic noise. The main differences are explained in the following chapters.

		METHOD M1	METHOD M2	METHOD M3	METHOD M4
REFERENCE SITUATION (see ch. 4.2)	Acoustical Parameters Used	L_{50}, L_{95}, L_{eq}	L_{10}, L_{50}, L_{95}, L_{eq}	L_{50}, L_{95}, L_{eq}	L_{10}, L_{50}, L_{95}, L_{eq}
	Measurements: Daytime analysis	• Measured *in situ*	• Measured *in situ*	• Measured *in situ*	• Measured *in situ* • Traffic Peak Hours Measured *in situ*
	Nighttime analysis	Analytical = k-10 dB(A)	Analytical = k-10 dB(A)	Analytical = k-10 dB(A)	
	Measurement Points Selection Criteria	• Location • Use • Limited by L_{Aeq} = 65 dB(A) in the final exploration year	• Location • Use	• Location	• Location • Use
	Measurement Duration	(not available)	until signal stabilization	15 minute	(not available)
	Mean Measurement Spacing (meters of road per measured point)	100 - 900	100 - 2000	2000 - 5700	(not available)
	Noise Zoning Classification (NZC)	• Lowly Noisy • Noisy • Highly Noisy	• Lowly Noisy • Noisy • Highly Noisy	• Lowly Noisy • Noisy • Highly Noisy	• Lowly Noisy • Noisy • High Noise • $L_{Aeq\ actual} - L_{95} \geq 10$ dB(A)
IMPACT ASSESSMENT (see ch. 4.3)	Acoustical Parameters Used	L_{50}, L_{eq}	L_{50}, L_{eq}	L_{eq}	L_{50}, L_{eq}
	Impact Assessment Analysis	each 5 year period	in the *completion* year	each 10 year period	each 5 year period
	Annoyance Rating	• Change in the NZC	• Change in the NZC • $(L_{Aeq} - L_{95})_{Prev} > 10$ dB(A)	• Change in the NZC	• Change in the NZC • $(L_{Aeq} - L_{95})_{Prev} > 10$ dB(A)
	Sound Level Prediction Tool	Software *WYLIE*®	Software *TRAF*®	Software *MICROBRUIT*®	Analytic calculation (CETUR)
MITIGATION MEASURES (see ch. 4.4)	*Construction stage*				
	Equipment Site Placement restrictions	"Far" from residential area	"Far" from residential area	residential area > 200 m	(not available)
	Noisy Operations Schedule restrictions	7:00 a.m. - 10:00 p.m.	7:00 a.m. - 10:00 p.m.	7:00 a.m. - 10:00 p.m.	(not available)
	Exploration stage				
	Acoustic Barriers - design method	software *WYLIE*®	software *BARR*®	software *MICROBRUIT*®	Analytic calculation (CETUR)
	Increase Facade Sound Isolation	• Double window • Double glass • Acoustic air entrances	• Sliding window • Double glass	• Double glass	• Double window • Double glass

Table 1 - Summary table of the four methodologies used in Portugal in the EIA studies regarding traffic noise.

4.2. Reference Situation

The characterization of the *Reference Situation* is supported by measurements *in situ* done by field teams to evaluate the acoustical parameters L_{Aeq} and L_{50}, and sometimes even the L_{10} and L_{95}.

These values obtained during daytime period (7:00 a.m. to 10:00 p.m.), indicate the normal background level on site. In the nighttime period (10:00 p.m. to 7:00 p.m.), only one of the design teams does measurements to achieve the *sound level in the night reference period*, all the others just assume a nighttime sound level inferior in 10 dB(A) to the daytime period. The influence of traffic peak levels in the environment sound level is analyzed only by one design team (M4).

The location of the measurement positions is chosen by the use and position of the existent buildings along the roadsides. Some of the consultant teams, instead of analyzing the entire site, choose some main regions considering them representatives of the surrounding areas.

Another point of discussion is the measurement duration. Some of the design teams refer the sound signal stabilization as their criterion and others adopt a fixed period (for instance, 15 minute like team M3). It should be considered the time *dilution* of the values obtained during the measurement campaign, to the totality of *reference period* duration, (as stated in Portuguese NP-1730). This is not done by any of the design teams.

The *Mean Measurement Spacing* (= number of measurements points/road length) has a strong variation, depending on the kind of site been tested, such as *urban*, *suburban* or *rural*, and the awareness of the technician who is doing the site recognition. In the analyzed EIA studies the *Medium Measurement Spacing* varies from 100 to 5700 m.

The next stage includes the Noise Zoning, according to the Portuguese General Noise Code, article 4: "*For this decree, the building site places are classified as Lowly Noisy, Noisy, Highly Noisy, according with the limits of the environmental sound levels, as described in Table 2.*"

Lowly Noisy zone	*Areas where the sound level respects the following limits:* $L_{50} \leq 65$ *dB(A) between 7 a.m. and 10 p.m.* $L_{50} \leq 55$ *dB(A) between 10 p.m. and 7 a.m.*
Noisy zone	*Areas not included in Lowly Noisy zone and respecting the following limits:* $L_{50} \leq 75$ *dB(A) between 7 a.m. and 10 p.m.* $L_{50} \leq 65$ *dB(A) between 10 p.m. and 7 a.m.*
Highly Noisy zone	*Areas not included in Lowly Noisy and Noisy zone definition*

Table 2 - Noise Zone Classification.

4.3. Impact Assessment

According to the present Portuguese General Noise Code, the noise impact assessment is supported on the acoustical parameters L_{50} and L_{Aeq}. The current practice by the consultant teams show that those environmental impacts are predicted for one of the following periods:

- the end of the road exploration period (usually 20 years);
- in three operational phases (o*utset, half-life* and c*ompletion* of the road exploration period);
- every 5 year-period.

Some of the design teams only use the L_{Aeq} parameter, not respecting the actual Portuguese General Noise Code (that states the L_{50} as the acoustical parameter regarding noise zoning classification), justifying them with the statement "*the proposal for the new General Noise Code refers the L_{Aeq} and not the L_{50} as the most representative parameter*".

The common methodology to assess the annoyance used by all the design teams, is expressed in the Portuguese General Noise Code (Article 28), where it states: "*The entities responsible by traffic planning, both road and train, should consider the necessity of avoiding noise due to their exploration, if the use of surrounding existent or predicted areas is incompatible with the noise generated by those traffic, using all measures available to noise protection.*" In practice, this is done by verifying the modification of the Noise Zoning Classification.

Another annoyance criterion, nevertheless not used by all the consultant teams, is the Article 20 of the same General Noise Code, where it states:

"1 - Referred to the article 3, the license for noise-producing activities, including those with traffic circulation, public or private, should respect the following statements:

a) The difference between the equivalent continuous sound level emitted, L_{Aeq}, *and the background noise,* L_{95}, *must be less or equal to 10 dB(A);*

b) The equivalent continuous sound level, L_{Aeq}, *referred in the previous point is measured according to the techniques described in the Portuguese standards;*

2 - If the license does not include the analysis indicated in article 3 or any kind of the limitations imposed in the next paragraph, it is assumed given and should respect the limits referred in the previous paragraph;

3 - The authorities that issue licenses or give authorization to noise-producing activities, can impose, under exceptional circumstances, strictly requirements adapted to each situation, to the places indicated in the first paragraph, in order to satisfy the regulations of the present Noise Code."

The prediction models used by the design teams to estimate the L_{Aeq} and L_{50}, have different theoretical bases and often do not give similar results to identical situations.

4.4. Mitigation Measures

The mitigation measures proposed by the design teams to prevent noise-related problems in the road neighborhoods, is established on the stage where it is analyzed. If they are considering the *construction stage*, the major problems are the result of noisy operations and the construction yard labor. To protect the built surrounding areas, the noisy activities must be performed during daytime (7:00 a.m. to 10:00 p.m.) and the construction yard must be placed faraway from the close residential areas.

In the *exploration stage*, the noise annoyance is important because there will exist increasing traffic for many years and, in consequence, the environmental noise background will be rising up. To avoid or to minimize this kind of noise, the design teams usually suggest different solutions like the use of acoustical barriers, the increase of sound isolation in the windows or a combination of the two previous practices.

When they specify increasing the facades sound isolation, it must also be considered the need to keep the correct airflow level inside the dwellings to prevent possible humidity problems. In this case a ventilation device with acoustical treatment should be designed (see *acoustic air entrances* in Table 1).

5. CONCLUSIONS

It has been shown above that, in Portugal, there are still no precise methodologies concerning EIA studies regarding traffic noise. The design teams are following the few Portuguese legislation and standards available. Notwithstanding the few EIA studies executed until now, generally their technical sustenance is acceptable.

For those reasons, there is a lack of uniformity of criteria inducing that the regulating bodies are not able to decide easily about their technical validity and legal compliance.

In face of these statements, one of the main conclusions of this paper is the recognition of a strong need for more studies especially with supportable theoretical background; for more legislation to clarify the actual uncertainties (even establishing restrictive rules to evaluate the *Impact Assessment* of a new road), and for new or adapted standards to establish the measurements methods. This new legal and normative ambiance will enable the authorities, to do a more precise and strict analysis of the future EIA studies.

In the near future, one of the desired and planned developments would be the announcement, by *JAE,* of new and detailed guidelines concerning road and highway projects to be constructed in the foreseeing years.

ACKNOWLEDGMENTS

The authors wish to recognize the University of Porto, the Institute of Construction and the National Road Services (JAE - *Junta Autónoma de Estradas*) for their support in this project.