THE ASSESSMENT OF THE NOISE POLLUTION DUE TO THE TRAFFIC IN BUCHAREST – CASE STUDIES

Talida Mirona CIRLIORU[1], Valeriu PANAITESCU[2]

There are many sources of noise pollution, most of which are associated with urban development; road, rail and air transport; industrial noise. In the present paper a series of measurements done with an integrated sound meter SOLO SLM (produced by 01 dB Metravib, France) will be presented. The results obtained during the measurements campaigns have shown different values that ranged between 57 -60 for Leq. According to the legislative document STAS 10009 – 88 on "Acoustic in construction – Urban acoustic, Admissible limits of noise level" the limits can range between 60 – 80 dB in function of technical category of the street.

Keywords: noise pollution, acoustic, urban traffic.

1. Introduction

Noise Pollution can be described as unwanted sound that unfairly intrudes into our daily activities. There are many sources of noise pollution, most of which are associated with urban development; road, rail and air transport; industrial noise; neighborhood and recreational noise. Many people are exposed to transport noise levels that affect their quality of life and health, notably in large agglomerations. The most important factor of the noise pollution is the disturbance made by the traffic, followed by commercial and industrial activities, buildings construction and public works [1].

In Bucharest, noise pollution is an important aspect of pollution in general and in the same time is also a threat to environmental quality of community, with water and air pollution.

The serious effects of transport noise have been recognized since the 1970s. For a long time, however, they received relatively little attention while the public focused instead on transport air pollution impact [2]. The situation is at last changing. Following the adoption of the Environmental Noise Directive in 2002, the EEA's recent TERM 2008 report Transports at a crossroads is the first to contain an assessment of EU-wide noise data. Its findings give cause for concern. 55% of those living in urban areas with more than 250 000 inhabitants in the EU-27 — almost 67 million people — endure daily road noise levels above the lower EU benchmark (55 L_{den}) for excess exposure [1,2].

[1] Eng, Power Engineering Faculty, University "Politehnica" of Bucharest, Romania
[2] Prof, Power Engineering Faculty, University "Politehnica" of Bucharest, Romania

In this paper, the studies done on several types of roads were the noise level was measured, will be presented and some recommendations will be done.

2. Legislation concerning noise pollution

European Parliament and Council adopted the Directive 2002/49/EC on 29 of June 2002 on the assessment and management of environmental noise. The main purpose of this Directive is to create a common basis for managing urban environmental noise [1].

The Directive does not establish limits on noise indicators, nor for measures to be taken in the action plans. Threshold limit values and measures that may be taken in the action plans are established by each Member State.

For the Romanian case the noise limits are established by the following official documents:

- STAS 10009-88 – Building Acoustics – Urban Acoustics – Permitted limits of noise level;
- STAS 6156-86 - (Building acoustics – Protection against noise in dwellings and public buildings – admissible limits and sound insulation values);
- STAS 6161/3-82 – Determination of noise level in towns – method of determination

The Directive has been transposed in the Romanian legislation by GD 321/2005, (updated later by GD 674/2007) according to which: "the environmental noise represents the unwanted or harmful sound from the environment created by human activities, that includes on one side the noise emitted by urban traffic, railway traffic, air traffic and on the other the noise from the areas where industrial activities are developed".

3. Materials and methods

Physicists define noise as a random superposition of different frequencies and intensities and physiologists considers noise as any sound that produces a disagreeable sensation. Instead for the International Organization for Standardization (ISO), the noise is "an acoustic phenomenon that produces an auditive sensation regarded as disagreeable" [3].

The physical characteristics of noise and sound refer to the intensity, duration and frequency. Noise levels are measured taking into account its intensity and the frequency of sounds that compose it. These features give the noise harmful potentialities, regardless of the preferences and individual mental state.

The measurement of noise level is made using sound-level meter, which automatically integrates data captured by the microphone.

In order to point out in a correct and complete manner the characteristics of noise evaluated sound level meter is provided with the possibility of frequency weighting [4]. This is due to the fact that only the middle frequencies are received with maximum responsiveness and the high or low frequencies can be mitigated. This weighting is important when the background noise is relatively low compared with that of the measured source. For different measurements, 4 weighting curves are standardized: A, B, C, and Z.

There are only two fundamental weighting filters currently used, A and C, each one corresponding to a frequency weighting curves well defined.

The legislation in Romania set the noise limits in the weighting curve A and the measurements results are expressed in weighted dB(A), dBA.

If the source emits a constant level of noise, the sound level meter indicates a constant value over time (the case of permanent sources with continuous emission of noise).

The emissions of variable sources have a noise that fluctuates in time. In order to characterize the noise, whose intensity varies over time and to measure the impact of noise disturbance at the international level was introduced the term of equivalent continuous sound level (Leq_A), weighted by the weighting curve A. The noise equivalent level is a standardized form of an average noise level on long-term.

The equivalent continuous sound level represents an average of sound level over a period of time. When the equivalent continuous sound level is calculated, the period of measurement should be always specified [4, 5].

The equivalent noise level can be directly registered with an integrating sound level meter, a dosimeter or calculated with a logarithmic formula.

One factor that can significantly influence the accuracy of the assessments of potential pollutant noise is the background noise level compared to the one generated by the measured source.

For the high background noise is necessary that the source noise to be at least 3 dB above the background noise in order to prevent the noise generated by the evaluated source.

If the difference $L_g - L_f$, where L_g is the global/total noise (noise measured with the noise source in operation) and L_f is the background noise level, is less than 3 dB, the background noise is too strong and accurate assessment of source is not possible. If the difference $L_g - L_f$ is between 3 and 10 dB a correction is required. The correction is done with the diagram presented in figure 1. If the difference $L_g - L_f$ is greater than 10 dB no correction of the results is required.

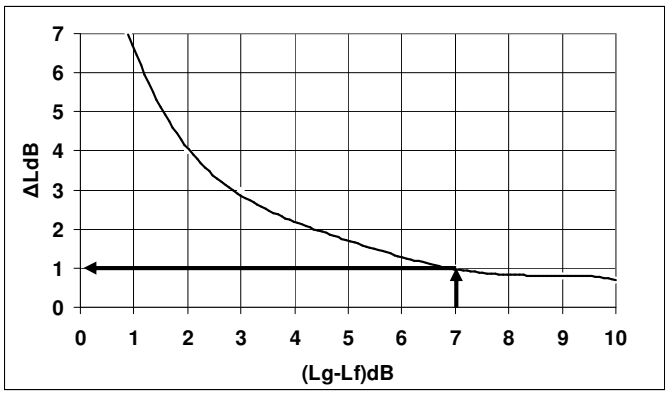


Fig. 1 . Chart for the correction of noise level

In order to do the correction, the following steps must be followed:

- the difference Lg - Lf, is attached to the abscissa chart;
- the ordinate ΔL is determined by identifying the intersection with the graph (see direction arrows marked).

The corrected noise level of the source will be: $L_{eq} = L_g - \Delta L$. For the final evaluation of the results the correct values of L_{eq} will be taken into account.

The outside noise level on the street is measured at the pavement border and the permissible values are established depending on the category of the street equipment (respectively the intensity of traffic) as in table 1.

Table 1

The outside noise level according to the STAS 10009-88

Nr. Crt.	Type of street	L_{ech}(dB)	Cz (dB)
1	Street A – technical class IV- local service	60	55
2.	Street B – technical class III - collecting	65	60
3.	Street C – technical class II –connection road	70	65
4.	Street D – technical class I – main road	75..85	70..80

In this case, the monitoring of the noise produced by road traffic in Bucharest was achieved using an integrating sound level meter SLM SOLO 01, 01dB mark Metravib-France, with a MCE 215 - manufacturer GRAS sound-level meter microphone.

Noise measurements were conducted according to Romanian legislation, in daylight (between the hours from 6^{00} to 22^{00}) and at night (between the hours 22^{00} to 6^{00}). Measurements were made for a time period of 3 minutes, the data registration being performed second by second in fixed points on the studied street. All the measurements have been done over a year period. The data obtained after these campaigns are presented in table 2.

Table 2

The data registered during the campaign measurements for the traffic noise on the streets of Bucharest

Type of street	Date	Day/Night	Leq [dB]	Lmin [dB]	Lmax [dB]	STAS 10009-88 [dB]
Street A – technical class IV- local service	04.08.2009	day	55,3	48,7	67,4	60
	-	-	-	-	-	-
Street B – technical class III - collecting	31.10.2008	day	67,6	61,2	78,3	65
	01.11.2008	night	54,0	50,2	66,4	65
Street C – technical class II –connection road	16.06.2009	day	70,6	56,2	81,9	70
	16.06.2009	night	68,6	44,1	78,6	70
Street D – technical class I –main road	20.09.2008	day	71,7	59,6	84,4	75..85
	19.09.2008	night	69,7	56,3	81,2	75..85

For the first type of street A – technical class IV- local service, the admissible value for the noise level, according to the STAS 10009-88, is L_{ech} = 60 dB. Unlike the other streets, for the street A, the measurements have been done only in daylight. The diagram of the noise level for this street is presented in figure 2. The measured L_{ech} did not exceed the limits imposed by law, the registered value was of 55 dB.

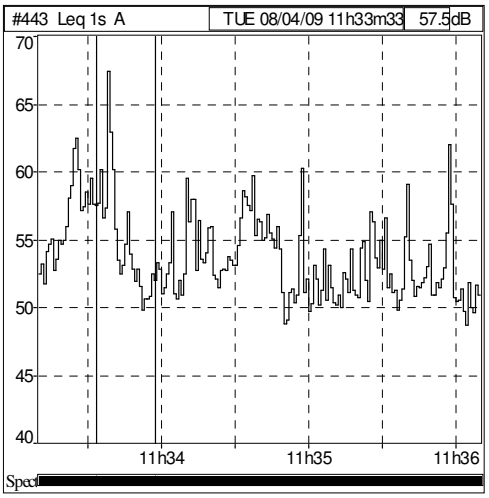
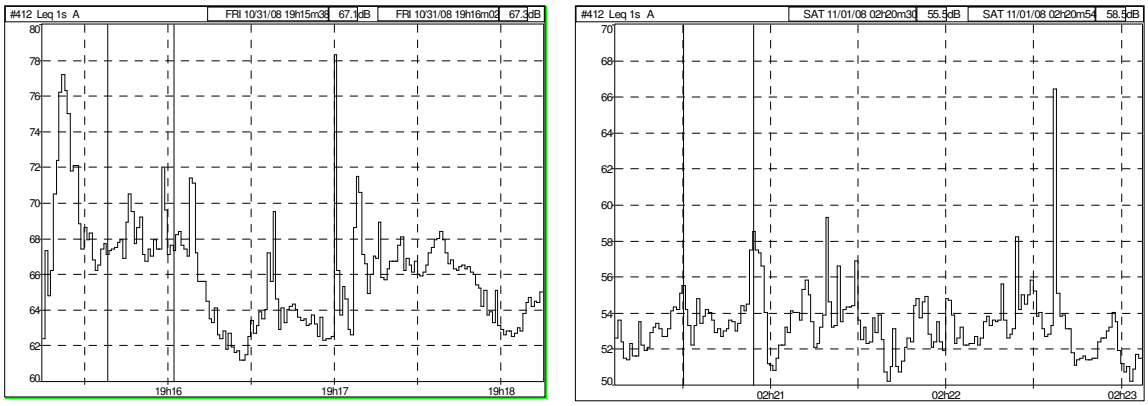


Fig. 2. The registered data for street A – technical class IV – local service

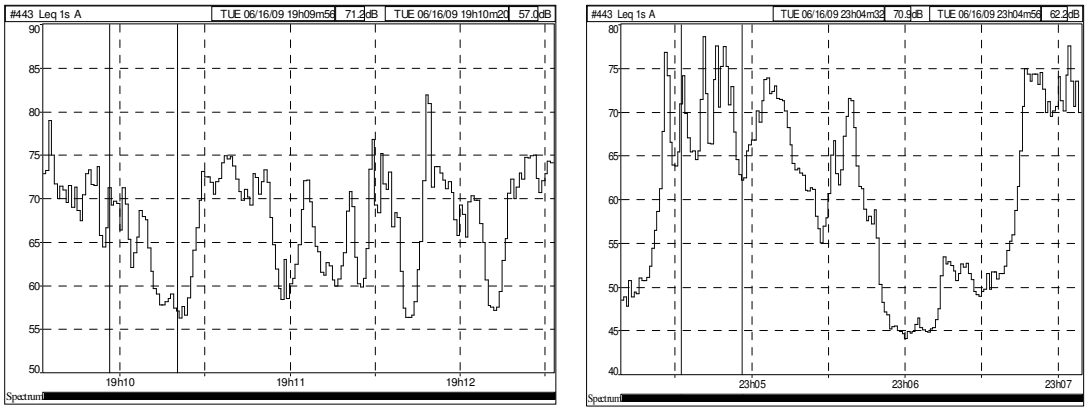
In the second case, for the street B – technical class III- collecting, the admissible value for the noise level, according to the STAS 10009-88, is L_{ech} = 65 dB. The measurements have been done both in daylight and at night. The diagram of the noise level for this street is presented in figure 3a and figure 3b. The measured L_{ech} did not exceed the limits imposed by law when it was measured at night (54 dB). Instead when the campaign was done on daylight the value exceed with 2.6 dB the limits imposed by the STAS 10009-88.



a) **b)**

Fig. 3. The measured data for street B – technical class III – collecting: a) daylight measurements; b) night measurements

The third case presents the data collected for a technical class II street that was considered a connection road. The admissible value for the noise level for this type of street, according to the STAS 10009-88, is L_{ech} = 70 dB. The measurements have been done both in daylight and at night. The diagram of the noise level for this street is presented in figure 4a and figure 4b. The measured L_{ech} did not exceed the limits imposed by law when it was measured at night (68.6 dB). Instead when the campaign was done on daylight the value exceed with 0.6 dB the limits imposed by the STAS 10009-88. Anyway the small difference that was registered has been ignored because of the fact that other factor could have been influenced this value.



a) **b)**

Fig. 4. The measured data for street C – technical class II – connection road: a) daylight measurements; b) night measurements

The last case study presents the data collected for a technical class I street that was considered a main road. The admissible value for the noise level for this type of street, according to the STAS 10009-88, is L_{ech} = 75..85 dB. The measurements have been done both in daylight and at night. The diagram of the noise level for this street is presented in figure 5a and figure 5b. The measured L_{ech} did not exceed the limits imposed by law (71.7 dB – on day and 69.7 dB – at night).

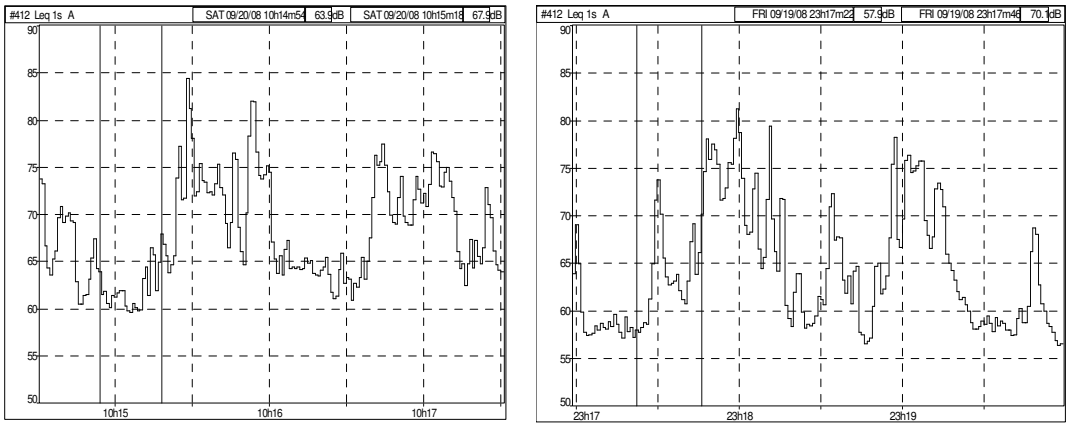


Fig. 5. The measured data for street D – technical class I – main road: a) daylight measurements; b) night measurements

6. Conclusions and discussions

From the presented examples it can be noticed the fact that urban traffic has a major influence on noise and on health population of Bucharest city. From the data measured can be noticed that the highest value registered on daylight was the one for the street D and for the night measurements the values were similar for street C and D (68.6 dB and 69.7).

But for a good estimate of noise is most suitable to study the noise map for the desired area/locality. Bucharest Municipality was the first city in Romania that in 2007 developed a map noise of the city.

Year 2007, according to Directive 2002/49/EC, was the deadline for submission of noise maps for major areas: agglomerations> 250,000 inhabitants; highways> 6,000,000 vehicles per year; railways> 60,000 trains / year; airports> 30.000 movements per year. Year 2012 represents the deadline for the noise maps submission for all areas, following that every 5 years the measures should be redone.

Bucharest Municipality has already launched an "Action Plan on Urban Noise," a study-strategy that presents solutions to reduce noise and improve comfort urban city. Among the solutions proposed by the study it is included aircraft flight interdiction over the city at night, rehabilitation tram lines, railways and old roads and the isolation of new houses against noise.

The study also proposes the installation of guard rails to absorb noise over the crowded arteries which pass through residential areas, encouraging the use of quieter vehicles and improved drivability, with courses offered drivers.

R E F E R E N C E S

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