

MEASUREMENT AND ESTIMATION OF NOISE INFLUENCE ON THE ENVIRONMENT

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ABSTRACT

The paper presents the main parameters of sound and noise and their possible influence on people. The comparative analysis has been performed between valid legal regulations in the EU and the US and the domestic legislations in the area. Based on the set procedures, the conducted measuring has been presented, as well as the noise level condition on the selected locations in accordance with valid standards. Considering the permitted noise levels, and based on the obtained measuring results, the propositions are provided for applying the necessary correction measures in order to decrease the noise level onto the permitted limitations on individual locations.

Key words: Noise, Legal regulative, Noise measurements, Environmental impact

INTRODUCTION

The sound is unavoidably present everywhere around us, whether its source is natural or artificial. The significance of the sound information reaching a person's ear cannot be neglected, though, on the other side, there is also the unwanted sound information which can distract a person in communication or the performance of mental activities, and this sound is commonly referred to as the noise.

In the situations of noise emissions in the environment, the sound has no permanent settlement or significant spatial expansion. For this reason there has been no need for international cooperation establishment. This set problem is one of the areas emphasised in this paper, together with the legal regulative in the Republic of Serbia (RS) and some other countries in the EU and the US. Apart from the influence on people's health, and noise level monitoring and reduction, the paper also deals with the principle of measuring the permitted noise levels and the elaboration of the report on noise level research in the environment.

In noise exposure, the quantity response differs from person to person, what is in direct connection to the following: person's age, health, temperament, and the like. Even with the same person, the reaction can alter depending on health and fatigue. High frequency and high intensity noise leads to incommodities with a large number of people. First, one can observe peripheral blood vessel contraction leading to the slower blood flow into the brain; then, breathing dynamics can fasten, muscle tension increase, and one can even feel the alimentary canal's over-movability and hormone stimulation, the traces of which can be detected in blood and urine. Sound stimulation intensity increase leads to greater organism reaction. If the stimulation is prolonged, the organism adapts, and a person is no longer aware of the causes while the primary effects continue. In the case of additional noise level increase, especially in impulse impacts and discontinuous impacts, the organism suffers a reaction known as the fear effect. Pulse and blood pressure alter, glucoses in the liver are released into the blood flow and adrenaline production increases. Noise level higher than 125dB leads to brain waves deformation, and not rarely to temporary disturbances in the sight. Other side-effects from the high noise level exposure are the following [1]:

- Permanent loss of hearing;
- Acoustic trauma;
- Speech disturbances;
- Sleep disturbances;
- Impact on work efficiency, etc.

LEGAL REGULATIVE

Legislation refers to: subjects of environmental protection from noise; measures and conditions for noise protection in the environment; noise measuring in the environment; access to information on noise; monitoring and other issues significant for environmental protection and people's health [3].

Determining the measuring interval: Measuring interval is determined according to the type of noise, and the minimal measuring interval has to be long enough to include the entire cycle of the level alterations in the observed noise. With the alternating noise, the level is measured in at least three measuring intervals per day, and at least two per night, where each interval lasts for at least 15 minutes [2]. Measuring interval for the day is from 6.00 am to 10.00 pm, and for the night is from 10.00 pm to 6.00 am (SRPS U.J6.090).

Common foundation for the interest in noise level everywhere in the EU has four main goals:

- Monitoring the environmental issues (elaborating the so-called strategic noise cards around the main sources – traffic routes with 16,500 vehicles/day, airports, railway, plants – with the standardised indicator, in order to estimate the number of population being negatively influenced by noise;
- Informing and consulting the public on exposure, influences and measures taken;
- Problem solutions – elaboration and implementation of action plans (the directive does not determine noise standards, nor types of measures – each member determines that for themselves) (possibilities – barriers, green bands, speed limits, limited type of traffic, etc);
- Elaborating the long-term EU strategy for providing the frame for long-term action to decrease the number of endangered citizens, directions for developing adequate policy for noise reduction at the source.

Acoustic space zoning conducted in certain states slightly problems the comparison of maximal noise levels permitted, though some most common types of noise, like the work place noise or residential zone noise can be presented comparatively [5]. The following tables list permitted noise levels in Serbia and the comparison to some EU member states.

Table 1: Permitted noise level in residential areas for the road traffic, in dB (A)

	Day period	Rest period	Night period
Austria	50 – 55		40 – 45
Denmark	55	55	55
France	60 – 65		50 – 57
Germany	50 – 55		40 – 45
Spain	60		50
Sweden	55	55	55
UK	55		45
Serbia	55 – 60		45 - 50

Table 2: Permitted noise level in residential areas for industrial noise sources, in dB(A)

	Day period	Rest period	Night period
Austria	50 – 55		40 – 45
Denmark	45 – 50	40 – 45	35 – 40
France	50 – 55	45 – 50	40 – 45
Germany	50 – 55		40 – 45
Sweden	50 – 55	45 – 50	40 – 45
UK	L90 + 10		L90 + 10
Serbia	55 – 60		45 - 50

In RS, the permitted values are perhaps lightly higher in relation to the values defined in some EU member states; however, this will not be further examined since this country cannot be compared to technologically more advanced and wealthier countries possessing newer and quieter machines that produce less noise. Regulative in RS does not precisely determine the type of noise and the table values for residential areas are considered in a more general aspect [4].

In the US, as well as in the EU, there is no uniform national law to regulate noise. However, one item led by the US is in the cases of building new residential and other facilities for dwelling, and states and cities have very strict criteria with the demands for acoustic analyses in order to protect dwellers from the outside noise and inside-building generated noise. Architects need to be in close collaboration with acoustic engineers for common most efficient and cheapest solutions for achieving a quiet interior (usually it is 45 dB).

INVESTIGATING THE NOISE LEVEL IN THE ENVIRONMENT

Noise measuring can be conducted on the basis of the users' demands or the demands of the City Management for Inspection, the area of environmental protection inspection. The environmental protection inspector, on official duty concerning a noise, based on the article 109, article 110 and article 111 of the Law on Environmental Protection (Official Gazette of the Republic of Serbia, No. 135/04), article 18 of the Law on State Administration (Official Gazette of RS, No. 79/05) and article 11 of the Law on Private Entrepreneurs [3], can issue a solution concerning the noise against the owner or the establisher of a facility, that the owner has to provide a report on the conducted measuring. The measuring has to be conducted by an authorized and accredited organization in accordance with the regulations on the permitted noise level in the environment.

Measuring report has to contain the following data: mark of the measuring place; date and parts of the day; noise source(s) (description, position, source condition, noise characteristics); measuring conditions (location description, weather conditions); measuring devices; measuring place and measuring points; measuring time and reference time; as well as measuring results.

When one determines on what type of measuring one can be focused and what limit values need to be pursued, one can begin with concrete measuring. All measuring have been performed by Bruel and Kjaer 2250 phonometer.

The measuring has been conducted in a referent residential unit in an individual housing structure. Noise level condition elaboration on the defined location has been performed in accordance with the set legal basis, for the day measuring period in the time interval between 12.30 am and 2.00 pm, and for the night measuring period in the time interval from 10.00 pm to 10.40 pm. Measuring has been performed in the listed intervals within day and night periods, having in mind the type and the character of potential noise sources on the set location.

The facility is situated in the commercial and residential zone of the residential town on a regional road and in a ground-floor structure. The measuring is conducted in a referent residential unit situated in the individual housing facility at the same location, located right next to a restaurant, sharing a same wall.



Fig. 1: Satellite picture of the position of the measuring place and investigated facility [5]

Considering the formerly defined objective of determining the noise level in the environment, as well as the assumed noise sources, the inspector's order state that the noise sources in the restaurant are as follows: the amplifier Yamaha type AX 392, receiver PIONEER type VSX 806 RDS, CD player TECHNICS type SL PG-590, speakers BOSE (4 pieces), mixer SAMSUNG and the air-conditioner (1 piece).

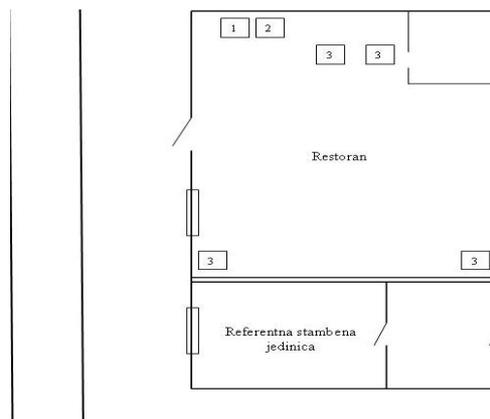


Fig. 2: Drawing of the facility with the order of the defined noise sources and their position in relation to the referent residential unit and measuring place

Due to the character of the potential noise sources at the treated location, the procedure of elaborating the noise level condition in the living quarters has implied measuring the equivalent noise level in the fifteen-minutes measuring time intervals, with the sampling velocity of 10 samples/s.

Noise level condition on the marked measuring place in the living quarters is the consequence of the noise created by the defined noise sources, traffic and communal activities of the surroundings at the observed location.

Table 5: Measuring No. 1

MEASURING PLACE – Room at the referent residential unit		Noise level in the living quarters – day period	
Measuring microphone – at the height of 1.4 m		L1 = 38.1 dB(A)	L90 = 29.5 dB(A)
Measuring period: 15 min		L10 = 35.5 dB(A)	L99 = 31.9 dB(A)
Evaluation of the impulse character	LAleq-LAeq=3,1 dB	L50 = 32.2 dB(A)	Leq = 33.0 dB(A)
		Correction:	Ldod = 0 dB(A)
		Competent level:	Ln =33 dB(A)
Permitted level:		Ldoz =35 dB(A)	

Exceeding the permitted level:	0 dB
Note: Measuring has been conducted with all defined noise sources turned on, and open doors and windows at the referent commercial facility	

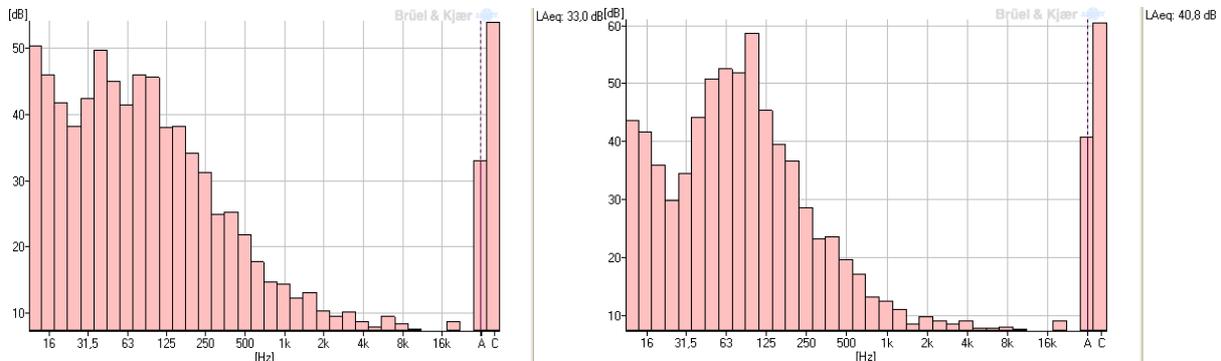


Fig. 3: Frequency chart of the noise level in the communal surroundings

Night measuring period:

If one has doubts that the noise arriving from outside from sources other than those being observed is approximately same or even higher than the noise produced by the listed noise sources, then the measuring with all defined noise sources turned off is conducted first, and only then the measuring with all defined noise sources turned on is conducted. After that, one utilizes a formula to calculate the competent level (the measure of noise exposure obtained by correcting the measured equivalent noise level for factors well known, as the factors enhancing the negative noise effects and depending on the character of the treated noise in frequency and time domain).

Table 6: Measuring No. 2

MEASURING PLACE – Room at the referent residential unit		Noise level in the living quarters – night period	
Measuring microphone – at the height of 1.4 m		L1 = 38.7 dB(A)	L90 = 29.6 dB(A)
Measuring period: 15 min		L10 = 35.4 dB(A)	L99 = 27.5 dB(A)
Evaluation of the impulse character	LAeq-LAeq=3,6 dB	Leq = 32.9 dB(A)	Leq = 33.0 dB(A)
		Correction:	Ldod = 0 dB(A)
		Competent level:	Competent level:
Exceeding the permitted level:		3 dB	
Note: Measuring has been conducted with all defined noise sources turned off			

$$L_{A,eq,1} = 10 \log(10^{L_{A,eq,1,2}/10} - 10^{L_{A,eq,2}/10}) \quad [\text{dB}] \quad (1)$$

where:

LA,eq,1 – Energy equivalent permanent A-level of the specific noise,

LA,eq,1,2 – Energy equivalent permanent A-level of the total noise,

LA,eq,2 – Energy equivalent permanent A-level of the noise at the measuring place.

CONCLUSION (CONDITION OF THE NOISE LEVEL IN THE LIVING QUARTERS)

The determined competent noise level in the living quarters of the referent residential unit, for the day period of the measuring with all defined noise sources turned on, with their full action that does not lead to sound deviation or device damage, for the measuring place, does not exceed the limit of the regulated value of the highest permitted noise level for the living quarters of residential structures (in the case when the noise source is in the building) of 35 dB(A).

The determined competent noise level in the living quarters of the referent residential unit, for the night period of the measuring with all defined noise sources turned on, with their full action that

does not lead to sound deviation or device damage, for the measuring place, exceeds the limit of the regulated value of the highest permitted noise level for the living quarters of residential structures (in the case when the noise source is in the building) of 30 dB(A).

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