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NOISE AS AN INDICATOR OF ENVIRONMENTAL QUALITY - PRE-MEASUREMENTS IN SELECTED AREAS IN THE MUNICIPALITY OF VELENJE

Abstract: *The noise in the living and working environment significantly reduces the quality of the environment. With the expansion of cities and consequently increase of traffic, the problem of noise increases significantly. The study was performed in Velenje, a large employment centre in Šaleška valley. In terms of population it is the fifth largest city in Slovenia. In recent years, Velenje is faced with the deterioration of environmental quality and increased noise, particularly around the city's main roads. In the last decade, this area is very active in investments (thermal power plant, Gorenje), and thus the living and working environment situation worsens. The longitudinal axis of the city is the concentration of traffic and industrial activity. The aim of the project was to create a professional basis and assess the degree of exposure of certain areas and its population to different sources of noise. The study is intended to prepare a quick and effective corrective measures for protection against the influence of noise.*

Key words: noise, environmental quality.

INTRODUCTION

This paper discusses the municipal noise, which refers to the external noise environment in the municipality of Velenje. The noise inside the accommodation and service spaces (buildings, workplaces, industrial plants etc.) does not belong to municipal noise. In the urban environment, transport is by far the most troublesome noise source. With the increase of traffic and spread of urban places the problem of noise also increases.

The solution to the problems with noise can be found in considered (sustainable) spatial planning of urban development that takes into account spacial and general city maps, detailed maps of urban planning and anticipating projects. Sustainable urban development planning must include the living habits of the population living in urban areas, the development of industrial, commercial and trading areas and areas for relaxation, fun and recreation as well as the transport needs of the city.

In the measurement of urban noise we measured the total of sound pressure level on the site of immisions, which means superposition of all noise sources, the close and distant, primary and secondary as well as parasitic ones. Measurements were carried out to: determine the noise impact of the measuring area (the city) with noise, compare with permitted limit values, determine the possible measures for protection against noise and identify the noise sources and their influential area, [1,2].

Current legislation in the field of environmental noise

Environmental noise is governed by two regulations in accordance with the Directive of European Parliament and Council 2002/49/EC of June 25, 2002. The basic law of protection against noise is the decree of noise in natural and living environment, its amendments and other regulations, [3]. Also important, is the »Regulation of noise from road and rail transport«. Both decrees define the evaluation of noise, its limits and measures to reduce and prevent excessive noise emissions or immissions. When planning the measurements we comply with the »Regulation on evaluation and regulation of environmental noise, OJ RS, no. 121/04. This regulation specifies, in accordance with the Directive of European Parliament and Council 2002/49/EC of June 25, 2002, concerning the assessment and regulation of environmental noise (UL L no. 189 of July 18, 2002, p. 12–26) and in order to avoid, prevent or reduce harmful effects, including interference caused by noise in the environment, measures to reduce the congestion of environment with noise, particularly in relation to methods of evaluation of environmental noise, the determination of noise exposure with mapping the congestion of populated areas with noise, providing access to information on environmental noise and its effects to the public, preparation of the operational programme for protection against noise pollution, which is based on the results of mapping the areas with noise congestion, with a view to prevent and reduce it, and the preparation of a programme of action in the areas of

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population, which are in the class of highest level of noise congestion and are because of the exposure defined as a degraded environment. The regulation on the limit values of environmental noise indicators, Gazette RS no. 105/2005 of November 23, 2005 and no. 105/ of November 7, 2008. The regulation on the limit values of environmental noise indicators, Gazette RS, in accordance with the Directive of European Parliament and Council 2002/49/ES of June 25, 2002, on the assessment and management of environmental noise, provides for, [4-14]:

- Rate of reduction of environmental pollution by noise,
- The limit values of indicators of noise in the environment,
- The critical values of indicators of noise in the environment,
- The provisional methods for assessment noise indicators,
- Adjustments that need to be taken in account for the calculation of the value of noise indicators in the use of the provisional methods for the assessment of noise indicators,
- Measures to reduce noise emissions in the environment,
- Taxpayers to ensure operational monitoring of noise for noise sources (herein after referred to as: operating monitoring) and
- The contents of environmental licence and situations, for which environmental authorisation does not need to be obtained.

The natural and living environment is divided into four levels of protection against noise, in which they allow different noise levels (limit, critical, taper) in the day and night time.

The regulation of protection concerning noise from road and rail traffic also classifies the environment in four different levels of protection; where individual noise level must not exceed the prescribed day and night noise level.

Policy on the first measurements and operational noise monitoring for noise sources and on conditions for their implementation and changes, Gazette RS, no. 70/96 specifies the kinds of quantities of the noise that need to be measured, and monitoring of the area laded with noise.

Experts who deal with planning of interventions in the environment are, in the context of their duty, required to make an assessment of impacts on the environment, which mostly include the following activities,:

- Carry out measurements in the field;
- Assess the specific origin of noise (the noise source);
- Calculate the expected noise levels;
- Produce a simulation of the load of the environment as a result of interference in the space (noise map);
- Informing the affected residents and wider community;
- Create databases for regular and later use;
- Participating in professional discussions about possible solutions.

AREA OF RESEARCH

Measurements were carried out on the territory of KS Gorica. It's a sloppy compact settlement of terraced single-family houses, placed next to and above of Goriška street, the main local vein, which leads to the Eastern city and suburban areas of Velenje. Main feature of the area is residential with the providers of various services. The hill side is rising up to 480 meters above sea level.

Next to the local traffic road a green belt is planted (a barrier) with the function of noise protection. In order to determine its effectiveness, we performed the measurements next to the road, and right after the green planting. We were also wondering, how the noise level varies with height and the distance from the noise source (the traffic), so we repeated the measurements one street higher (Splitska Street). The lowest measurement point on the Goriška Street was located at 397 metres above sea level, and the highest measurements were done on Splitska Street at 413 metres above sea level.

Figure 1. *The distribution of monitoring sights (Mapping basis: Google Earth, content: N. Špeh)*

All measurements were carried out in the open. The noise next to traffic was measures 2 metres from the edge of the road at height of 1.5 metres. Measurement of noise was carried out on working days during the week from 12:30 to 14:30. The measuring site and the results of measurements are displayed in the web application Google Earth or Google Maps and with geographic information tool ArcMap 10.2.

RESULTS OF MEASURMENTS

Noise immissions are highly dependent on the micro location. The noise strongly varies with distance from the source (e.g. road), but the possible presence of physical barriers (e.g. buildings) between the source and the location of observation is also important. At the same time, temporal fluctuations are also important, [15, 16].

We structured the data into five categories: 1) 0 to 40 dB, 2) 41 to 55 dB, 3) 56 - 60 dB, 4) 61- 65 dB and 5) above 65 dB.

Base line measurements point (19) was pinned 2 meters from the edge of the road (on the map 1, they are marked with no. 1-19). The value of the measurement fluctuated from 54.2 dB (min) to 75.3 dB (max). The calculated average value of sound directly at the road was 67.5 dB

Followed by a parallel line of measurement (18 monitoring stations), which we did behind the green barrier (map 1, marks 20-37). In some parts, the measured values of noise clashed with three categories lower than those of roadside (2nd category: 41-55 dB). Values ranged between the absolute lowest 51.7 dB to highest 73.2 dB. The calculated average value for noise, measured behind the barrier, was 61.6 dB, which meant almost 6 dB less than the average values measured directly next to the lane of Goriška street. With the repetition of measurements in 2013, we find a greater influence of the green barrier; the difference in average values between road line and behind the barrier amounted to 10 dB.

Green barrier in the width of about two metres represents the planting of shrubs and pine trees. Less commonly planted shrubs affected the results of measurements, because there the instrument detected higher values, in some cases even of same category as directly to the Goriška Street. The data advocate the positive influence of green barrier usage. Additional (thicker, wider) planting might achieve even more effective anti-noise protection.

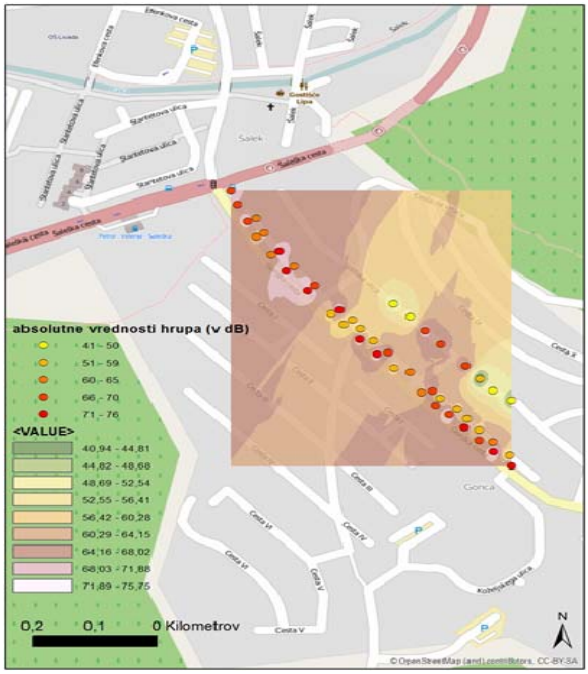

Figure 2. *The level of noise in certain measuring points*

CONCLUSION

Noise in the living and working environment represents an important disturbance for a human and may significantly lower the quality of the living environment. In the urban environment transport (road) noise is by far the most troublesome. However, the problem of noise increases with the increase of traffic. Velenje, the fifth largest city by population in Slovenia (25.329, municipality of Velenje 32.973, SURS, 2014), is an important employment centre, but at the same time it also has a transit role. In recent years, it is faced with a deterioration of the quality in the living environment, that is with transgression of burden with noise, in particular at the cities arteries. The negative

impact is also reflected next to the valley axis in the direction to the neighbouring municipal centres, Šoštanj and Šmartno ob Paki. This valley axis represents the concentration of traffic and industrial activity in connection to settlement function of the space. In the last decade, this area is very investment active (TEŠ, Gorenje), which additionally worsens the situation of living and working environment and these parts of Savinja statistical region. Similarly, the traffic congestion increases beyond the urban area of the valley. There is an increasing pressure of transport activity on rural areas in the Šaleška valley, which represent a strong hinterland in terms of daily migration.

The results are represented by preliminary measurements that need to be upgraded (repetition in different times of day), if we were to use them for making the expertise with which we would determine the degree of exposure of individual areas (and the population) to various sources of noise. This is the only way we could have prepared a detailed spatial presentation and a set of necessary measures. The results of further studies could also be used for: a) creation of proposals on anti-noise measurements throughout the area with a special treatment for noise-critical parts of the municipality Velenje and b) with data, we would complement the spatial basis (plans) and define the conditions for purposive use of space (OPN municipalities) and to determine the levels of protection against noise.

The purpose of solving the noise problem, its prevalence and spatial distribution on a wide range Šaleška valley originated from the need to update the basis for municipal spatial plans of the discussed municipalities, where for decades pressures of various anthropogenic activities come in line.

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BUKA KAO POKAZATELJ KVALITETA ŽIVOTNE SREDINE - PRELIMINARNA MERENJA U ODABRANIM OBLASTIMA OPŠTINE VELENJE

Nikola Holeček, Natalija Špeh

Rezime: *Buka u životnoj sredini značajno smanjuje kvalitet životne sredine. Problem buke se značajno povećava širenjem grada i posledičnim porastom saobraćaja. Studija je izvedena u Velenju, velikom centru za zapošljavanje u Šaleškoj dolini i petom gradu po broju stanovnika u Sloveniji. Velenje je u poslednjih nekoliko godina suočeno sa pogoršanjem kvaliteta životne sredine i povećanom bukom, posebno oko gradskih magistralnih puteva. U poslednjoj deceniji se u ovo područje veoma aktivno investira (Termoelektrana Šoštanj, Fabrika Gorenje),čime se bitno pogoršava stanje životne sredine. Uzdužna osa grada predstavlja koncentraciju saobraćaja i industrijskih aktivnosti. Cilj projekta je bio stvaranje profesionalne osnove i procene stepena izloženosti pojedinih oblasti i stanovništva različitim izvorima buke. Studija je namenjena pripremi brzih i efektivnih korektivnih mera za zaštitu od buke.*

Ključne reči: buka, kvalitet životne sredine.